CANE DETERIORATION AS AFFECTED BY BILLET SIZE, DELAY IN MILLING AND OTHER FACTORS

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Abstract

Trials were conducted to determine comparative changes with time in weight, juice quality and recoverable sugar of whole stalk and chopped sugarcane of several varieties, and to study the effect of billet size on rate of deterioration. In addition, an estimate was made of size distribution of billets from a chopper harvester. It was concluded that under hot, humid conditions chopped cane deteriorates much faster than whole stalk cane, rate of decline in purity and recoverable sugar tending to increase with decrease in stalk length, while reducing sugars showed a corresponding increase. The chopper harvester, set to cut 30 cm billets, delivered a high proportion (25%) of short billets (< 20 cm) many of them immature and partly damaged, and these would tend to accelerate deterioration under field conditions.

Introduction

The advent into the South African sugar industry of chopper harvesters for sugarcane has focussed attention on problems related to post harvest deterioration of chopped cane in other parts of the world, particularly Australia. A number of Australian and other workers (Egan[1], Egan and Rehbein[3], Irvine and Legendre[6], Kirby[9], and Vallance and Young[10]) have reported on the increased rate of deterioration of chopped cane by comparison with whole stalk cane, and the importance of keeping periods of storage before its processing to a minimum. Changes in juice quality, the effects of burning, weather and varieties and more recently the effect of billet size on cane deterioration have received attention (Gentry and Gascho[5], Irvine and Legendre[6], Ivin[7] and Ivin and Bevan[8]).

In this paper results are reported of three trials with chopped cane, two of them conducted in collaboration with the Tongaat Sugar Company which operates a chopper harvester.

Procedure

Trial 1

The object of this trial was to study deterioration in several varieties of whole stalk and chopped cane, both burnt and unburnt at time of harvest.

Five varieties (N50/211, NCo 382, NCo 376, N51/168 and N53/216) of ratoon cane aged 18 months were used. The unburnt cane was taken from the net plots of a variety trial, and two days later the cane set aside to allow for end effects and the guard rows were burnt and harvested. Samples comprising 280 randomly selected stalks of unburnt or burnt cane of each variety were taken on day 0. Each of these samples was then made into 40 bundles, each consisting of seven stalks. Each batch of 40 bundles was immediately weighed and then treated as follows:

(*a*) 16 bundles were retained as whole stalk samples, 4 bundles being analysed for changes in juice quality on days 0, 1, 2 and 5 after harvest.

(*b*) 12 bundles were chopped into 40 cm lengths and rebundled, and 4 bundles were analysed for changes in juice quality on days 1, 2 and 5 after harvest.

(*c*) 12 bundles were chopped into 20 cm lengths and treated as in (*b*) above.

All bundles except those for analysis on day 0 were returned to the field. Selected bundles were subsequently reweighed on the day of sampling in order to determine changes in weight with time. All determinations were carried out on stripped whole stalks which had been topped by hand. All analyses reported were carried out on first expressed juice and were based on the java ratio.

During the period of the trial on unburnt cane (12/11/73-17/11/73), a total of 8,7 mm of rain was recorded, all of which fell on day 1. During the burnt cane trial (14/11/73-19/11/73) 6,4 mm of rain fell on day 5. Temperature and humidity were low throughout, humiture at 2 pm reaching 90 on one day only.

Trial 2

In trial 1, differences in rates of deterioration between whole and chopped stalk were generally far smaller than had been expected from overseas results. This was probably because of the relatively cool conditions and low humidity prevailing at the time, but possibly also because the chopped cane was left outside to dry (see Figure 1) rather than being closely packed with neighbouring billets as would be the case in the field bin. In this latter condition chemical and biochemical changes within the stalk would probably have been accelerated. To seek confirmation of this and study further the effect of billet size on rate of cane deterioration a second trial was conducted using chopper harvested cane under hotter, more humid conditions.

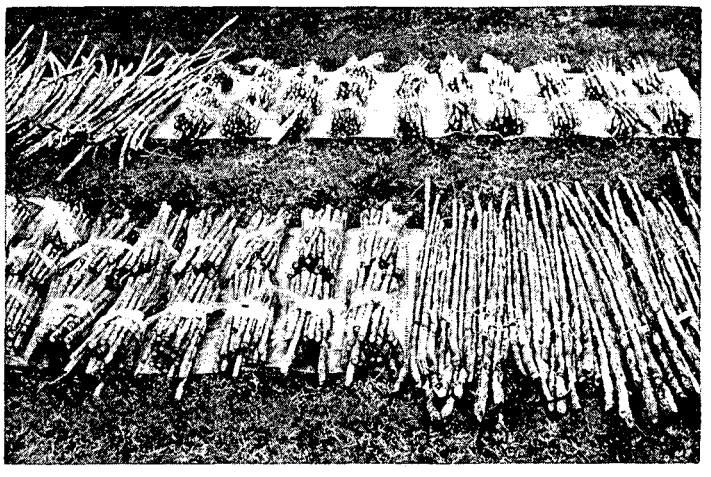

FIGURE 1 Whole stalk and chopped cane of several varieties (Trial 1).

(*a*) 24 rectangular metal baskets 54 litres (2 cu ft) in volume were placed in a cane bin and filled with chopped, burnt cane direct from the harvester. The baskets were weighed on day 0 and all but those for immediate analysis were stacked outside under cover (see Figure 2). Selected baskets were subsequently reweighed on the day of sampling in order to determine changes of weight with time. On each day of sampling 4 baskets were examined as follows: With an average billet size of 30 cm, the cane in each basket was separated into billets of 30 cm or longer and less than 30

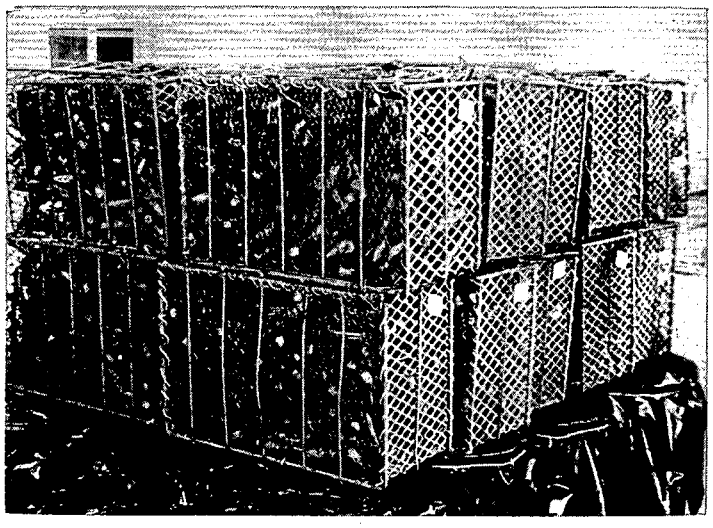

FIGURE 2 Chopper harvested cane in baskets.

cm. The long and short billets were weighed and counted before analysis, and extraneous material (leaf, trash, etc) was discarded.

(*b*) 24 plastic dustbins were placed around a loaded cane bin and chopper harvested cane was dropped into them by hand. In this instance trash and immature stalk were discarded at the time when the dustbins were filled so that extraneous matter was minimal. The bins were weighed on day 0 and all but those for immediate analysis were kept outside with the tops covered in plastic sheeting to create conditions of high humidity conducive to rapid deterioration. Selected bins were subsequently reweighed on the day of sampling but no measurable changes in weight were recorded as the plastic sheeting had prevented moisture loss. On each day of sampling 4 bins were examined and the contents divided into long and short billets as for the baskets. For both the baskets and the bins, the long and short billets were analysed separately for changes in juice quality, and recoverable sugar, on days 0, 1, 2, 3, 4 and 5 following harvest, as were bundles of whole stalk cane taken from the same rows as the chopper harvested cane on day 0. In addition first expressed juice from both the long and the short billets and the whole stalk cane was analysed for changes in pH, purity and reducing sugars with time. During the period of the trial (22/1/76-27/1/76) the weather was hot and the humidity generally high, the humiture at 2 pm on days 0-4 averaging 94. Plant cane of variety NCo 376 was used and an extremely even and hot burn was achieved.

TRIAL 3

The results of trial 2 emphasised the need for further information regarding the distribution of immature stalk (i.e. green tops etc.) between long and short cane billets, and the effect, if any, of such stalk on rate of deterioration of long and short billets.

Sixteen dustbins were placed in a cane bin and filled with chopped cane direct from the harvester. The bins were weighed

TABLE 1A

Losses due to deterioration of five varieties of unburnt cane harvested as whole and chopped stalk

(Means of four bundles adjusted for change in weight)*

Trial 1A — November 1973 (mean temp. 19,1°C)

Day	Rs % Pol			Purity %			Pol % cane			Ers % cane			Units rec. sugar			Weight loss %		
	Ws	40 cm	20 cm	Ws	40 cm	20 cm	Ws	40 cm	20 cm	Ws	40 cm	20 cm	Ws	40 cm	20 cm	Ws	40 cm	20 cm
									N50/211									
0	1,58			89,7			14,8			13,1			100			—		
1	1,72	2,10	2,38	88,6	88,1	87,5	14,3	13,8	13,4	12,5	12,0	11,6	95,4	91,6	88,5	1	2	2
2	1,43	1,98	2,83	89,9	89,6	87,1	14,5	14,2	13,1	12,8	12,5	11,3	97,7	95,4	86,3	1	1	1
5	2,57	2,47	2,41	86,9	88,3	88,2	14,2	14,1	13,5	12,2	12,3	11,8	93,1	93,9	90,1	5	6	10
									NCo 382									
0	0,97			91,5			15,3			13,7			100			—		
1	1,22	1,16	1,46	91,3	92,5	90,7	15,3	15,1	15,0	13,7	13,6	13,3	100	99,3	97,1	1	1	2
2	1,15	1,49	1,71	91,8	91,7	91,3	14,9	14,8	14,8	13,3	13,3	13,2	97,1	97,1	96,4	1	1	1
5	2,17	2,09	2,05	91,2	90,7	90,3	15,2	14,9	14,6	13,6	13,3	13,0	99,3	97,1	94,9	5	7	9
									NCo 376									
0	0,83			91,7			15,0			13,4			100			—		
1	0,92	0,93	1,42	91,3	91,0	91,9	14,5	14,4	14,4	12,9	12,8	12,9	96,3	95,5	96,3	1	2	2
2	0,95	1,05	1,47	92,1	91,9	90,7	14,7	14,4	14,4	13,2	12,9	12,8	98,5	96,3	95,5	2	2	2
5	4,37	3,05	2,92	86,6	88,8	88,9	13,7	13,5	13,7	11,8	11,8	12,0	88,1	88,1	89,6	6	8	10
									N51/168									
0	1,15			90,8			15,2			13,5			100			—		
1	1,25	1,00	1,01	91,0	91,2	91,2	14,9	15,1	14,8	13,3	13,5	13,2	98,5	100	97,8	1	2	2
2	1,20	1,00	0,88	90,8	91,6	91,2	14,7	14,4	14,6	13,0	12,9	13,1	96,2	95,6	97,0	1	2	2
5	1,68	1,15	1,30	89,4	90,4	89,9	14,7	14,6	14,1	13,0	13,0	12,5	96,2	96,2	92,6	4	6	9
									N53/216									
0	0,80			92,2			15,7			14,2			100			—		
1	0,71	0,72	1,08	91,9	92,1	91,8	16,3	16,2	15,9	14,6	14,6	14,3	102,8	102,8	95,1	1	2	2
2	0,96	1,05	1,21	90,5	91,7	92,0	15,6	15,8	15,8	13,9	14,2	14,2	97,9	100	100	2	2	3
5	4,35	3,38	3,91	88,4	89,3	88,4	15,2	15,2	14,6	13,3	13,4	12,9	93,7	94,4	90,8	5	7	10
									Mean									
0	1,07			91,2			15,2			13,6			100			—		
1	1,16	1,18	1,47	90,8	91,0	90,6	15,1	14,9	14,7	13,4	13,3	13,1	98,6	97,8	95,0	1,0	1,8	2,0
2	1,14	1,31	1,62	90,0	91,3	90,5	14,9	14,7	14,5	13,2	13,2	12,9	97,5	96,9	95,0	1,4	1,6	1,8
5	3,03	2,43	2,52	88,5	89,5	89,1	14,6	14,5	14,1	12,8	12,8	12,4	94,1	93,9	91,6	5,0	6,8	9,6

* Figures adjusted for weight loss or gain from that on day 0.

TABLE 1B

Losses due to deterioration of five varieties of burnt cane harvested as whole and chopped stalk

(Means of four bundles adjusted for change in weight)*

Trial 1B — November 1973 (mean temp. 20,2°C)

Day	Rs % Pol			Purity %			Pol % cane			Ers % cane			Units rec. sugar			Weight loss %		
	Ws†	40 cm	20 cm	Ws	40 cm	20 cm	Ws	40 cm	20 cm	Ws	40 cm	20 cm	Ws	40 cm	20 cm	Ws	40 cm	20 cm
									N50/211									
0	2,57			88,0			14,3			12,4			100			—		
1	2,46	2,22	2,59	89,9	89,3	89,9	14,1	14,1	14,2	12,5	12,4	12,6	100,8	100	101,6	4	5	5
2	1,95	2,39	2,36	89,8	89,7	89,3	14,5	14,1	14,1	12,9	12,4	12,4	104,0	100	100	6	7	9
5	2,88	3,26	4,13	88,1	86,9	86,8	13,8	13,4	13,4	12,0	11,5	11,6	96,8	92,7	93,5	7	8	10
									NCo 382									
0	1,60			90,5			15,0			13,3			100			—		
1	1,12	1,27	1,57	91,8	92,8	92,0	14,7	14,7	14,4	13,2	13,3	12,9	99,2	100	97,0	4	5	7
2	1,51	2,01	2,26	91,7	91,3	90,4	14,8	14,6	14,1	13,3	13,0	12,5	100	97,7	94,0	6	8	9
5	2,32	2,68	3,67	89,5	89,5	88,1	14,1	14,2	13,8	12,4	12,5	12,0	93,2	94,0	90,2	8	8	10
									NCo 376									
0	0,65			92,9			14,6			13,2			100			—		
1	1,05	1,07	1,30	91,7	91,2	92,0	14,4	13,7	14,0	12,9	12,2	12,6	97,7	92,4	95,5	5	5	7
2	1,44	1,53	1,94	91,9	91,0	90,8	14,2	14,1	13,7	12,7	12,6	12,2	96,2	95,5	92,4	7	7	10
5	2,33	3,64	4,45	89,7	88,2	87,2	13,7	13,2	12,5	12,1	11,5	10,8	91,7	87,1	81,8	9	9	11
									N51/168									
0	0,96			91,3			14,6			13,0			100			—		
1	1,02	1,14	1,30	91,2	89,5	90,7	14,6	14,3	13,8	13,0	12,6	12,3	100	96,9	94,6	4	5	6
2	1,22	1,34	1,71	90,5	90,3	89,9	14,6	14,3	13,6	13,0	12,7	12,1	100	97,7	93,1	4	7	9
5	1,76	2,25	2,54	89,3	89,5	88,8	14,0	14,0	14,0	12,3	12,4	12,3	94,6	95,4	94,6	5	7	9
									N53/216									
0	0,97			91,1			16,0			14,3			100			—		
1	1,04	1,46	1,79	92,1	91,4	91,6	15,7	15,4	15,3	14,2	13,8	13,8	99,3	95,6	96,5	4	5	6
2	1,70	2,01	2,34	91,4	91,0	90,8	15,4	15,3	15,0	13,8	13,7	13,4	96,5	95,8	93,7	5	6	9
5	2,95	4,85	5,48	88,6	87,0	87,4	14,8	14,8	14,3	13,0	12,8	12,5	90,9	89,5	87,4	7	7	8
									Mean									
0	1,35			90,8			14,9			13,2			100			—		
1	1,34	1,43	1,71	91,3	90,8	91,2	14,7	14,4	14,3	13,2	12,9	12,8	99,4	97,2	97,0	4,2	5,0	6,2
2	1,56	1,86	2,12	91,1	90,7	90,2	14,7	14,5	14,5	13,1	12,9	12,5	99,3	97,3	94,6	5,6	7,0	9,2
5	2,25	3,34	4,05	89,0	88,2	87,7	14,1	13,9	13,9	12,4	12,1	11,8	93,4	91,7	89,5	7,2	7,8	9,6

* Figures adjusted for weight loss or gain from that on day 0. † Ws = whole stalk.

on day 0 and all but those for immediate analysis were kept outside with the lids on, so that negligible weight loss was recorded on subsequent days of analysis. On each day of sampling 4 bins were examined as follows. The contents were divided into long and short billets which were weighed and counted before analysis. The trash present was also weighed. The number of immature stalks in each group of long and short billets was also determined and these were weighed separately. In addition, on each day of sampling, all billets from one of the 4 bins analysed were measured to obtain information on billet size distribution.

The long and short billets were analysed separately for changes in juice quality and recoverable sugar.

During the period of the trial (2/2/76-6/2/76) humidity was very high and humiture at 2 pm on days 1 and 2 being 107 and 110, respectively. Plant cane of variety NCo 376 was used.

Results and Discussion

Trial 1

Tables 1A and 1B show changes that occurred in whole and chopped cane stalk in reducing sugarr, purity, pol, estimated recoverable sugar (ers), units of recoverable sugar and weight, for unburnt and burnt cane of each of the five varieties, together with the mean changes for all varieties. The figures have been adjusted for changes in weight which occurred as the trials progressed.

Unburnt cane

Differences between whole and chopped stalk in rates of deterioration during the first five days after harvest were relatively small in all varieties. There was evidence of a more rapid decline in pol, ers and units of recoverable sugar with time in the 20 cm billets than in the 40 cm billets and whole stalk cane, in all varieties except NCo 376. Because of rain on day 1, drying out of the cane occurred rapidly only during the latter part of the trial when it became apparent that percentage weight loss with time increased with decrease in stalk length. Initially, reducing sugars increased most rapidly in the shortest billets though this tendency was not maintained throughout the sampling period.

Burnt cane

Differences in rates of deterioration between whole and chopped stalk though small, were somewhat greater and more clearly seen in the burnt than in the unburnt cane of all varieties. Rate of decline in units of recoverable sugar with time increased as stalk length decreased, this being particularly marked in varieties NCo 376 and N53/216, while reducing sugars showed a corresponding increase with decrease in stalk length for all varieties as the trial progressed. From the outset percentage weight loss with time increased with decreasing stalk length until day 5 when rain fell.

Differences between whole stalk and chopped cane in rates of deterioration especially in the early stages of the trial were generally far smaller than might have been expected from results reported elsewhere, possibly because of the relatively

TABLES 2A AND 2B

Summary of results from deterioration trial 2 (chopped cane in baskets vs whole stalk cane)
(All values means of four replicates — January 1976, mean temp 24,0°C)

2A

	Whole stalk							Long + Short Billets*						
Day	Dm %	Fibre %	Purity %	Pol. %	Ers %	Units recov. sugar	Weight loss/gain %	Dm %	Fibre %	Purity %	Pol. %	Ers %	Units recov. sugar	Weight loss/gain %
0	25,4	11,5	85,8	11,9	10,3	100	—	26,6	11,9	88,2	13,0	11,4	100	—
1	24,4	11,0	83,5	11,2	9,5	92	−2,0	26,4	12,1	87,5	12,6	11,0	96	−3,1
2	25,6	11,7	82,3	11,5	9,6	93	−2,7	26,3	12,0	86,2	12,2	10,6	93	−6,7
3	25,2	11,3	85,7	11,9	10,3	100	−5,8	25,3	11,5	82,7	11,3	9,6	84	−9,3
4	27,1	12,4	84,1	12,3	10,5	102	−3,8	24,8	11,6	77,9	10,3	8,2	72	−15,6
5	26,2	11,9	87,9	12,5	11,0	107	−5,1	24,6	11,3	80,1	10,7	8,8	77	−14,8

* results weighted in proportion to sample weight

2B

	Long Billets (30 cm +)							Short Billets (< 30 cm)						
Day	Dm %	Fibre %	Purity %	Pol. %	Ers %	Pol. % Dm	% of sample weight	Dm %	Fibre %	Purity %	Pol. %	Ers %	Pol. % Dm	% of sample weight
0	27,6	12,3	90,0	13,8	12,3	49,9	61	25,1	11,3	85,0	11,8	10,1	46,8	39
1	27,8	12,7	89,0	13,5	11,9	48,4	62	26,4	12,1	85,2	12,2	10,5	46,1	38
2	28,8	13,2	88,1	13,8	12,2	47,9	64	26,9	12,5	82,6	11,9	10,0	44,2	36
3	28,4	12,9	84,4	13,1	11,1	46,0	70	26,7	12,3	78,6	11,3	9,1	42,4	30
4	30,4	14,1	80,0	13,0	10,6	42,9	70	27,4	13,0	72,2	10,4	7,7	37,9	30
5	29,1	13,3	81,1	12,8	10,6	44,1	76	28,6	13,4	76,9	11,7	9,2	40,9	24

TABLES 3A AND 3B

Summary of results from deterioration trial 2 (chopped cane in bins vs whole stalk cane)
(All values means of four replicates)

3A

	Whole Stalk							Long + Short Billets (weighted)						
Day	Dm %	Fibre %	Purity %	Pol. %	Ers %	Units recov. sugar	Weight loss/gain %	Dm %	Fibre %	Purity %	Pol. %	Ers %	Units recov. sugar	*Weight loss/gain %
0	25,4	11,5	85,8	11,9	10,3	100	—	27,5	12,4	90,8	13,7	12,4	100	—
1	24,4	11,0	83,5	11,2	9,5	92	−2,0	27,3	12,3	87,1	13,1	11,5	92	—
2	25,6	11,7	82,3	11,5	9,6	93	−2,7	27,2	12,4	85,7	12,7	11,0	89	—
3	25,2	11,3	85,7	11,9	10,3	100	−5,8	26,4	12,1	82,7	11,8	9,9	80	—
4	27,1	12,4	84,1	12,3	10,5	102	−3,8	26,0	12,1	79,2	11,0	8,9	72	—
5	26,2	11,9	87,9	12,5	11,0	107	−5,1	25,6	12,0	82,5	11,2	9,4	76	—

* assumed negligible weight loss as bins covered

3B

	Long Billets (30 cm +)							Short Billets (< 30 cm)						
Day	Dm %	Fibre %	Purity %	Pol. %	Ers %	Pol. % Dm	% of sample weight	Dm %	Fibre %	Purity %	Pol. %	Ers %	Pol. % Dm	% of sample weight
0	27,7	12,6	91,6	13,9	12,6	50,2	73	26,9	11,9	88,7	13,3	11,8	49,4	27
1	27,6	12,4	87,8	13,3	11,7	48,3	69	26,6	11,9	85,6	12,6	10,9	47,4	31
2	27,5	12,5	86,2	13,0	11,3	47,2	74	26,4	12,1	83,7	12,0	10,1	45,3	26
3	26,7	12,2	83,4	12,2	10,3	45,4	79	24,8	11,7	79,6	10,4	8,5	42,0	21
4	26,4	12,3	80,1	11,3	9,2	42,8	78	24,8	11,6	76,3	10,1	7,9	40,3	22
5	25,9	12,0	83,2	11,5	9,7	44,5	78	24,8	11,9	79,8	10,4	8,4	41,7	22

cool conditions and low humidities which prevailed during the trial and for other reasons already stated.

TRIAL 2

Tables 2 and 3 (A and B) show the changes that occurred in dry matter, fibre, purity, pol, ers and sample weight of the long and short billets both in baskets and plastic bins, in comparison with changes in whole stalk cane during the 5 days following harvest.

Tables 2A and 3A show changes in units of recoverable sugar for the whole stalk cane and the long and short billets combined, the figures having been adjusted for changes in weight with time. From these tables it is evident that, from the outset, deterioration of chopped cane was rapid both in baskets and in bins and by day 4 some 28% of the recoverable sugar had been lost whilst losses in whole stalk cane over the same period were negligible.

Decline in purity, pol and ers between day 0 and day 4 in the short billets, both in baskets and bins (see Tables 2B and 3B) indicates that they were deteriorating more rapidly than the long billets over the same period. (Days 0-4 have been taken into consideration as, for some reason, analytical values tended to increase somewhat on day 5). This observation was confirmed by the greater decline in purity and increase in reducing sugars of the first expressed juice from the short billets, when compared with juice from the long billets and from whole stalk cane (see Figures 3 and 4).

There is also some evidence to suggest that both long and short billets in the bins were deteriorating faster than those in the baskets where conditions might have been expected to be less conducive to rapid deterioration than in the bins. Between day 0 and day 4 decline in ers% in the long and short billets in the bins was 3,4 and 3,9 respectively while in the baskets it was only 1,7 and 2,4. The pH of the first expressed juice from chopped cane in the bins also showed a dramatic

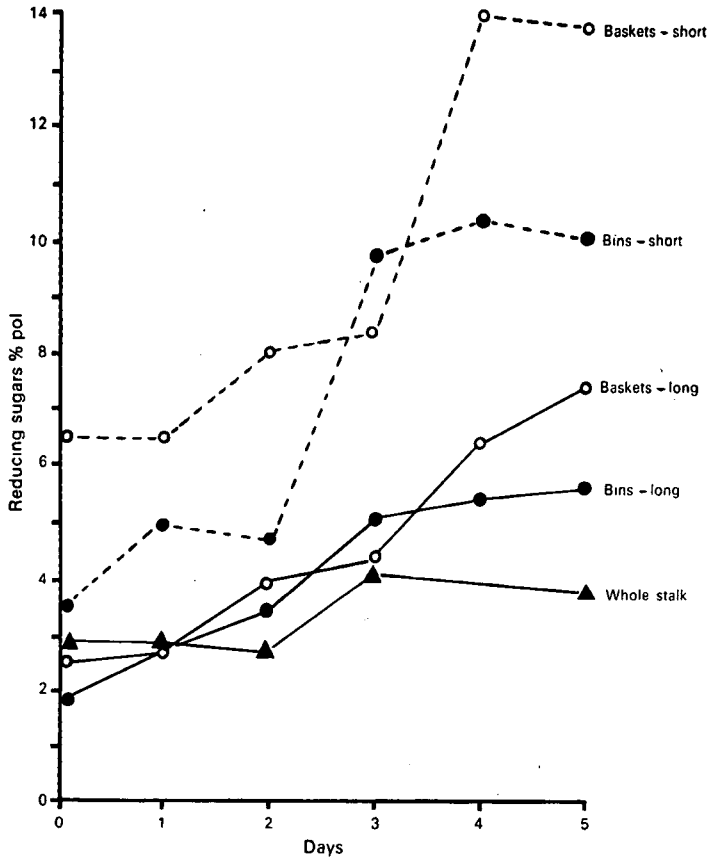

FIGURE 3 Increase in reducing sugars with time (Trial 2).

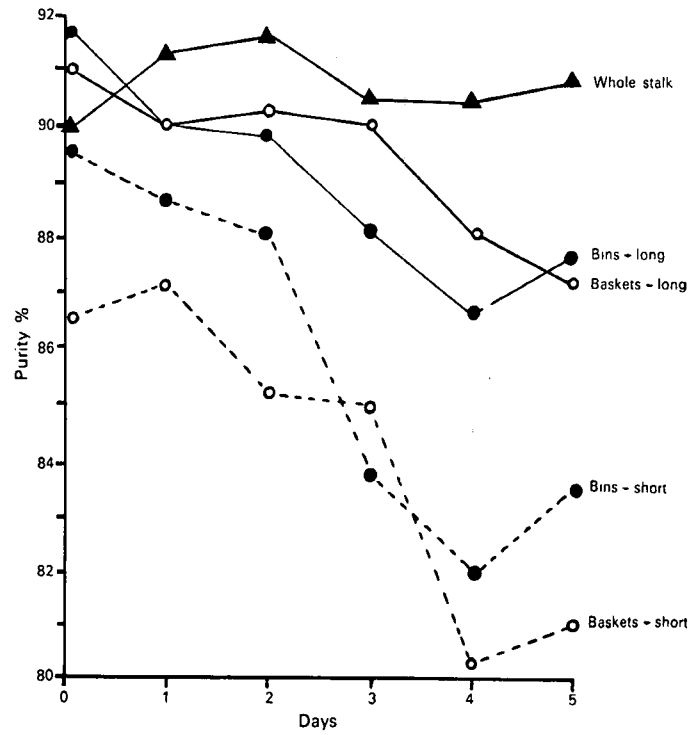

FIGURE 4 Decline in juice purity with time (Trial 2).

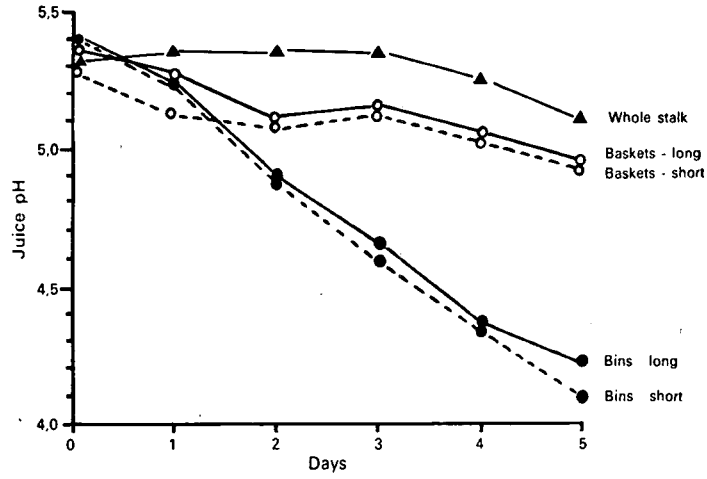

FIGURE 5 Decline in juice pH with time (Trial 2).

decline when compared with that from the baskets or from whole stalk cane (see Figure 5). Such a considerable drop according to Egan[2] is associated with rapidly deteriorating cane and is due mainly to the presence of acid forming micro-organisms, such as *Leuconostoc mesenteroides* which produces lactic acid, and is held to be responsible for the biosynthesis of dextran in deteriorated cane. However, more recent studies (Fulcher and Inkerman[4]) indicate that the pH of first-expressed cane juice cannot be used to indicate the presence of, or concentration of dextran, which does not appear to be a reliable indicator of deterioration as was once thought.

From Table 2B it appears that the short billets in the baskets contained a greater proportion of immature stalk material than the long billets, purity and pol of the short billets on day 0 being 5% and 2% lower, respectively, than that of the long billets. A similar trend was apparent in the short billets in the bins (see Table 3B) though this was not nearly so marked since the majority of immature stalks had been discarded at the time when the bins were filled. The noticeable decline in the percentage of the total sample weight contributed by the short billets in the baskets, as the trial progressed, indicates

TABLE 4

Division of immature stalk between long and short billets and summary of results*
Trial 3 — February 1976 — mean temp 26,2°C

Day	Long billets (30 cm+)						Short billets (< 30 cm)						% trash by weight
	% total by wt.	% tops by wt.	avge. wt. tops g	Purity %	Pol. %	Ers %	% total by wt.	% tops by wt.	avge. wt. tops g	Purity %	Pol. %	Ers %	
0	51,4	—	—	83,2	9,9	8,4	42,8	—	—	77,1	8,0	6,3	4,6
1	57,1	15,0	2 208	84,8	10,2	8,7	35,9	23,7	2 198	76,2	8,1	6,3	4,0
2	60,2	14,2	2 142	83,7	10,7	9,0	34,0	24,1	2 058	76,7	8,6	6,7	3,0
3	52,6	15,7	2 062	81,3	9,6	7,9	40,5	20,0	2 012	73,3	7,7	5,7	3,7
Mean	55,3	15,0	2 137	83,2	10,1	8,5	38,3	22,6	2 089	75,8	8,1	6,2	3,8

* All values in the body of the table are means of 4 replicates

that they dried out more rapidly than the long billets, and probably this was due, in part, to the relatively large amount of immature stalk present in the short billets.

TRIAL 3

Because of considerable variation between individual samples collected directly into bins from the chopper harvester, analytical results from this trial were inconclusive although some useful information was obtained with regard to the division of immature stalk between long and short billets.

The data in Table 4 show that, on average, a bin contained by weight 55% long billets, 38% short billets and approximately 4% trash. Immature stalk material accounted for roughly 15% of the weight of the long billets and 23% of the short billets, while the actual weight of immature stalk was about equally divided between the long and short billets. This satisfactorily explains the lower pol, purity and ers values obtained for the short billets, both in this trial and in trial 2.

With the chopper harvester set to cut 30 cm lengths of cane almost 1 000 billets collected directly into 4 of the bins were measured in order to obtain an estimate of billet size distribution. Figure 6 shows that about two thirds of the billets were between 25 and 34 cm in length, while a quarter of them were less than 20 cm long. This represents a relatively high proportion of very short billets; many of them were immature and often damaged, so that they would tend to deteriorate very rapidly under field conditions. This emphasises the need for minimum delays in delivery to the mill.

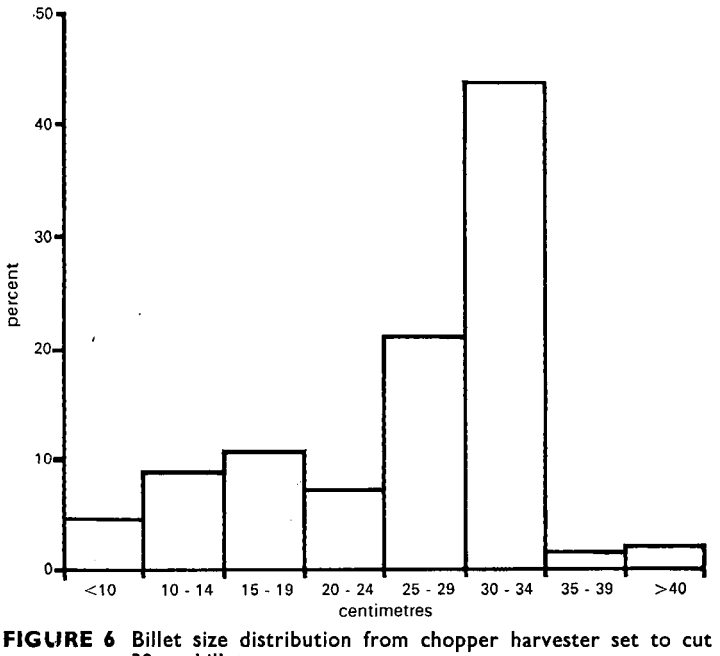

FIGURE 6 Billet size distribution from chopper harvester set to cut 30 cm billets.

Conclusions

(1) Under hot, humid conditions chopped cane deteriorates far more rapidly after harvest than whole stalk cane, losses of up to 28% recoverable sugar being incurred within 4 days of cutting.

(2) Rate of decline in purity, pol and ers with time, tends to increase with decrease in stalk length while rate of production of reducing sugars shows a corresponding increase.

(3) There were no large differences in rates of deterioration of chopped cane between several varieties during a period of 5 days following harvest.

(4) Rapid deterioration under conditions of high humidity is associated with a marked decline in the pH of juice from chopped cane (1,3 pH units in 5 days).

(5) Billet size distribution studies reveal that a chopper harvester set to cut 30 cm billets delivers a relatively high proportion of short billets (25% less than 20 cm long) many of them immature and partially mutilated, which will tend to accelerate deterioration under field conditions.

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