POST-HARVEST DETERIORATION OF WHOLE STALK SUGARCANE TREATED WITH CHEMICAL RIPENERS

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Abstract

Two trials were conducted to determine changes in cane mass, juice quality, and recoverable sugar following harvest of unburnt whole stalk sugarcane which had been treated with the chemical ripeners Mon 8000 and Ethrel. The cane was partitioned in order to assess the effects of ripeners on the top, middle and bottom sections of the stalk. Mon 8000 significantly reduced the rate of post-harvest deterioration in one trial; Ethrel had no such effect in either trial.

The large effects in terms of stalk 'ripening', 'loading' and growth brought about by the two ripeners generally had small effects on post-harvest deterioration rates. The results emphasise that delays between harvesting and milling should be kept to a minimum to avoid substantial losses of recoverable sugar.

Introduction

In a recent report Eastwood[1] indicated that the chemical ripener Polaris (N-N - bis (Phosphonomethyl) glycine) had slowed down the rate of post-harvest deterioration of sugarcane in Jamaica. Such an effect could have important implications for the South African sugar industry where delays of three or four days between harvesting and milling commonly occur, and where the value of chemical ripening of sugarcane is currently the subject of intensive investigation. It was therefore decided to study the effects of two ripeners, namely Mon 8000 and Ethrel, on the rate of post-harvest deterioration of unburnt whole stalk sugarcane, at two different times during the milling season. Two existing ripener trials were used, and in both Ethrel and Mon 8000 were applied at 0,75 kg and 0,60 kg active ingredient per hectare respectively, and compared with an unsprayed control treatment. Table 1 is a summary of the main differences between the two ripener trials.

TABLE 1

Details of the two ripener trials

ITEM	TRIAL 1	TRIAL 2
Site	Shakaskraal	Natal Estates (Burnside)
Variety	NCo 376	N55/805
Water regime	Irrigated	Rainfed
Sprayed	28th April 1977	15th October 1977
Harvested	31st August 1977	23rd November 1977
Age at harvest	11 months	12 months
Crop	3rd ratoon	Plant

Procedure

Both trials were undertaken with the object of examining comparative changes in cane mass, juice quality and recoverable sugar at the time of harvest, and 2, 6 and 9 days later.

In Trial 1, 11 month-old ratoon cane of variety NCo 376 was used while in Trial 2, 12 month-old plant cane of variety N55/805 was taken. Stalk sampling was randomised within six replicates and the sampling procedure was similar for the two trials.

For each treatment i.e. control, Mon 8000 and Ethrel, four bundles of 12 stalks were removed from each replicate on day 0. One bundle from each replicate was analysed for sucrose on days 0, 2, 6 and 9 after harvest (i.e. 6 bundles of 12 stalks per sampling day, per ripening treatment).

All 72 bundles were weighed on day 0 and the top and bottom 50 cm of each stalk was marked. Day 0 samples were then milled, while the bundles for milling on days 2, 6 and 9 were placed side by side on a lawn, and subsequently reweighed just prior to analysis in order to determine changes in mass with time. All analyses were carried out on stripped whole stalks which had been topped by hand at the natural breaking point.

Each bundle was milled separately in three sections, (top, middle and bottom) and these were analysed for fibre and juice quality. First the top 50 cm of each stalk was fed into a disintegrator, followed by the middle and then the bottom 50 cm. The mass of each section was determined as milling progressed.

Weather conditions during Trial 1 (31/8/77 - 9/9/77) were reasonably consistent as shown in Figure 1, and no rain was recorded. Maximum and minimum temperatures were generally higher during Trial 2 (23/11/77 - 2/12/77) and 24 mm of rain fell on day 6. The average humiture during Trial 2 was well above that in Trial 1, and conditions generally were more conducive to rapid deterioration.

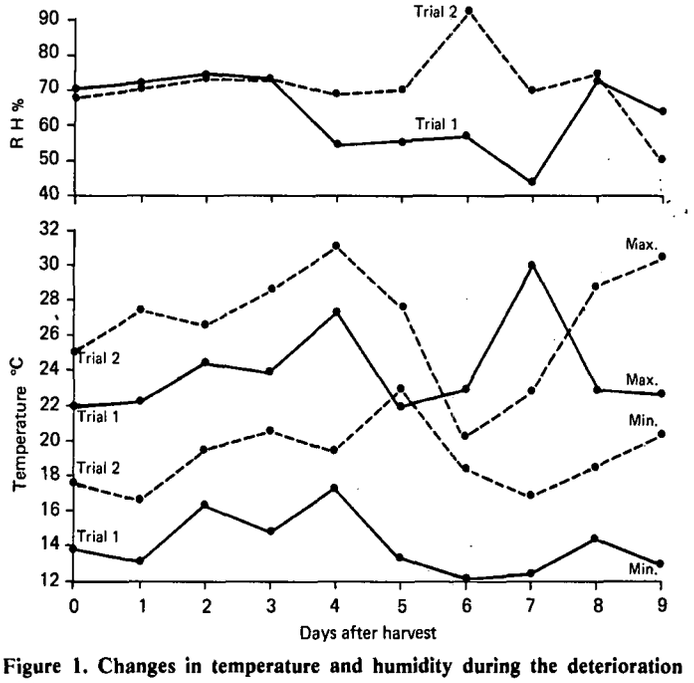

Figure 1. Changes in temperature and humidity during the deterioration trials

Results and Discussion

Whole stalk cane

The data in Table 2 show the changes which occurred in juice purity, % pol, % estimated recoverable sugar (ers) and cane mass over a period of 9 days, for the two ripening treatments compared with control, in Trials 1 and 2, except where indicated. The figures have been adjusted for changes in mass which occurred as the trials progressed. Changes in dry matter, brix and fibre contents have not been shown as they were small and inconsistent.

Mon 8000 and Ethrel increased % ers at harvest in Trial 1 by improving juice quality, while in Trial 2 only Mon 8000 had this effect. The lack of response to Ethrel in this case can be attributed to the high juice purity of 91% at time of application of the chemicals, compared with a juice purity of 70% in Trial 1.

TABLE 2

Summary of the results from the deterioration trials (Means of six replicates adjusted for change in mass from day 0)

Treatment	Day	Juice Purity %		% Pol		% ers		Units recov. sugar		Change in mass, % day 0	
		Trial		Trial		Trial		Trial		Trial	
		1	2	1	2	1	2	1	2	1	2
Control	0	87,8	89,9	12,7	13,5	11,1	12,1	100	100	100	100
	2	88,4	86,4	12,4	13,0	10,9	11,3	98	93	97	96
	6	79,9	71,2	11,3	10,8	9,2	8,0	83	66	94	92
	9	74,3	68,3	10,1	10,1	7,7	7,1	69	59	91	90
Mon 8000	0	90,0	93,0	14,8	16,7	13,3	15,3	100	100	100	100
	2	90,5	87,0	14,2	15,7	12,8	13,8	96	90	97	96
	6	84,7	76,8	14,0	13,3	12,1	10,5	91	69	94	93
	9	81,8	71,7	13,0	12,8	10,9	9,6	82	63	91	91
Ethrel	0	91,1	87,8	14,2	13,0	12,8	11,4	100	100	100	100
	2	89,8	83,4	13,7	12,4	12,3	10,5	96	92	98	96
	6	82,8	68,7	12,7	10,1	10,8	7,2	84	63	94	92
	9	76,8	65,3	11,5	9,5	9,2	6,4	72	56	91	90
LSD (P=0,05)		2,6	2,8	0,7	0,5	0,8	0,6	–	–	–	–
C.V. %		2,6	3,1	4,5	3,2	6,3	4,7	–	–	–	–

Although the rate of desiccation was similar in both trials for all three treatments (9 - 10% loss of moisture by day 9), the rate of deterioration was more rapid in Trial 2 than in Trial 1. Mon 8000 in Trial 1 was the only treatment which significantly reduced the rate of deterioration. Figure 2 shows that by day 9 in Trial 1, Mon 8000 treated stalks had lost only 20 g of ers compared with 31 g and 34 g in the control and Ethrel treatments respectively. The rapid decline in recoverable sugar after day 2 in all treatments of the second trial, confirms that delays between harvesting and milling should be kept to a minimum

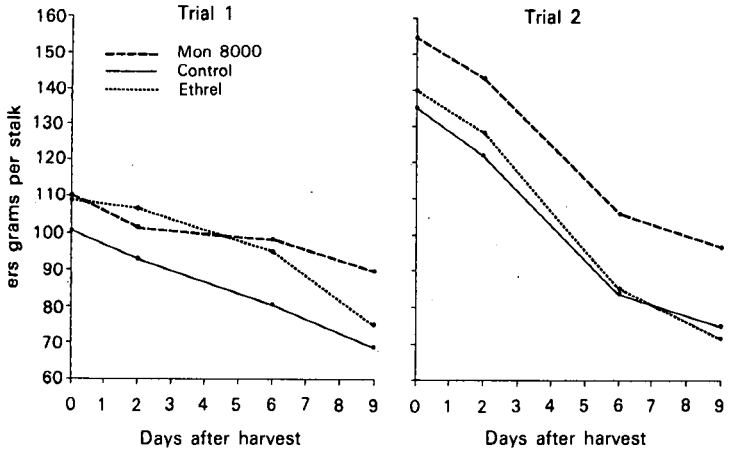

Figure 2. Changes in ers (g/stalk as analysed) with time, in whole stalk cane from two chemical ripening trials (Means of six replicates)

Partitioned stalk

Partitioning was carried out primarily to assess the effects of Mon 8000 and Ethrel on the top, middle and bottom sections of the stalk, as noticeable growth differences between the various treatments were observed in both trials at harvest. These effects on growth produced a middle section which varied in length according to treatment as shown in Table 3. It can be seen that the inhibition of apical growth by Mon 8000 reduced stalk length on average by 13 cm compared with the unsprayed stalks in both trials, whereas in Trial 2, Ethrel unexpectedly appeared to stimulate growth, producing a longer middle section.

Table 4 shows juice purity, % pol, and % ers in the top, middle and bottom sections of the stalk, for the two ripening treatments compared with control, at time of harvest of Trials 1 and 2.

TABLE 3

Mean stalk length (cm) at harvest (Means of twelve bundles)

Trial	Control	Mon 8000	Ethrel
1	213 (113)*	200 (100)	209 (109)
2	193 (93)	180 (80)	205 (105)

*** Length of middle section**

TABLE 4

Summary of results from partitioned stalks at harvest (Means of six replicates – as analysed)

Treatment	Part of stalk	Juice Purity %		% Pol		% ers		g ers	
		Trial		Trial		Trial		Trial	
		1	2	1	2	1	2	1	2
Control	Top 50 cm	73,3	74,0	8,8	8,5	6,6	6,5	10,6	19,6
	Middle	89,3	93,8	13,5	15,4	12,0	14,2	60,9	73,2
	Bottom 50 cm	92,5	94,8	13,5	15,5	12,2	14,3	29,7	41,7
Mon 8000	Top 50 cm	82,0	88,0	11,8	13,7	9,9	12,0	14,3	32,6
	Middle	90,9	94,4	15,5	17,9	14,0	16,6	61,1	72,1
	Bottom 50 cm	92,3	94,7	15,3	17,7	13,9	16,4	34,8	50,4
Ethrel	Top 50 cm	83,5	61,7	11,3	6,5	9,6	4,0	13,8	11,9
	Middle	92,4	92,8	14,9	15,0	13,7	13,7	63,3	84,6
	Bottom 50 cm	92,4	94,0	14,4	15,4	13,1	14,1	31,7	43,1

The effects of the chemical ripeners at the time of harvesting were very marked. Inhibition of apical growth by Mon 8000 and its ripening effects resulted in a considerable improvement in juice quality, particularly in the top section of stalk when compared with that of control in both trials, and with Ethrel in Trial 2. Also compared with control, Mon 8000 increased % pol in the bottom section of the stalk without an increase in purity. This process has been termed 'loading' as opposed to 'ripening', as the latter is also associated with an increase in juice purity. The stimulation of growth induced by Ethrel in Trial 2 resulted in a top section with very poor juice quality.

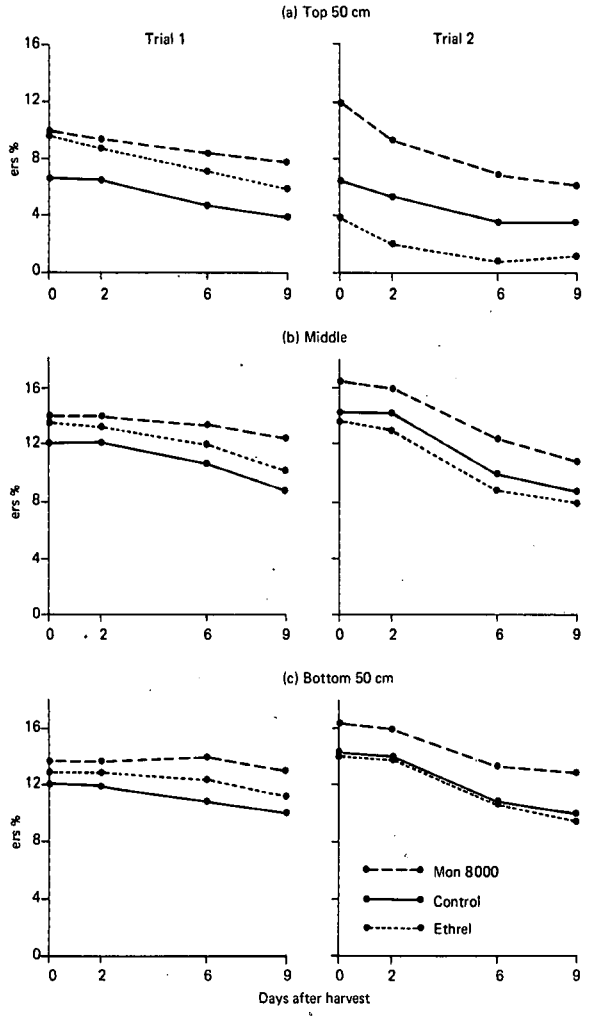

Figure 3. Changes in ers % with time, in partitioned cane stalks from two chemical ripening trials (means of six replicates)

Despite the large differences at harvest in 'ripening', 'loading' and growth brought about by the application of Mon 8000 and Ethrel, they had only a relatively small effect on post-harvest deterioration rates. This is demonstrated in Figure 3 by the changes in % ers with time in the partitioned stalks. The only exception was the Mon 8000 treatment in Trial 1 in which rate of decline in % ers was slowed down in all portions of the stalk. At this stage however it is not certain what factors e.g. season, variety, time elapsed since spraying, were responsible for the reduction in rate of deterioration when Mon 8000 was used.

Conclusions

1. The chemical ripener Mon 8000 significantly reduced the rate of post-harvest deterioration in all parts of the cane stalk in one of two deterioration trials.
2. Although Mon 8000 and Ethrel had large effects on 'ripening', 'loading' and growth they had only small effects on postharvest deterioration rates.
3. Further work is necessary to determine those factors responsible for variable deterioration rates following harvest when Mon 8000 is applied to cane.
4. The results confirm the substantial loss in mass of ers due to delays between harvesting and milling.

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