CHEMICAL RIPENING WITH ETHREL UNDER COMMERCIAL CONDITIONS IN SWAZILAND

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Abstract

Two rates of Ethrel (48% m.v.) were sprayed by aeroplane onto 0,3-0,4 ha strips of sugarcane *cv* NCo 376 in 24 fields at Ubombo Ranches, Swaziland on 8 April and 1 May 1975. Ethrel at 2 ℓ/ha improved sucrose percent cane fresh mass and juice purity, resulting in an average increase of 0,8 tons estimated recoverable sugar per hectare (ters/ha). There was little further yield increase at a rate of 3 ℓ/ha. Results were similar for fields sprayed on the two occasions and harvested between 6 and 15 weeks later during May, June and July. In a second replicated trial in one field there was a yield response to 1 ℓ/ha Ethrel of 1,4 ters/ha with no further increase at 2 ℓ/ha Ethrel. A new product Am 74/A382 was tested and found to be as effective a ripener as Ethrel. The addition of urea to Ethrel was ineffective.

Introduction

Ethrel has shown considerable promise as an artificial sugarcane ripener when tested in both small and large-scale field experiments at a number of locations (Rostron[1], [2], [3]). Application between 6 and 18 weeks before harvesting, in water volumes ranging from 25 to 400 ℓ/ha, has resulted in substantial improvements in sucrose percent cane (expressed on both a fresh and a dry matter basis), juice purity, and the estimated mass of sugar recoverable at the mill.

In early work with chemical ripeners Rostron[1] it was established that the best ripening response in variety NCo 376 under South African conditions was obtained with young, actively growing sugarcane harvested at the beginning of the milling season. This type of sugarcane was therefore selected in subsequent experiments, even in large scale field trials in which the response was assessed on the basis of large volumes of cane crushed commercially at the mill (Rostron[3]).

In commercial practice it may not always be possible to spray sugarcane at exactly the right stage of growth. Even within one sugarcane field there may be appreciable variations in growth and natural cane quality resulting from variations in soil or management factors. It is therefore important to know whether a good response to Ethrel can be obtained under average field conditions. The first of two experiments at Ubombo Ranches, Swaziland was therefore designed so that Ethrel was applied at two rates to large strips of sugarcane in all fields of variety NCo 376 due for harvest in the first three months of the milling season. In each field uniform areas of sugarcane were selected for the experiment but neither the fields, nor the order in which they were harvested was selected.

The second experiment was fully replicated within one field of variety NCo 376 and compared two rates of Ethrel with Ethrel and urea as well as a new compound, Am 74/A382.

Methods

Experiment 1

(*a*) Experimental procedure

A total of 24 fields was available for the experiment, half of these being sprayed on 8 April 1975 and the remainder on 1 May 1975. Normal irrigation and drying off procedures were followed in all fields. Each field was regarded as a replicate and contained the following three treatments:

1. Control, not sprayed
2. Ethrel 2 litre product/ha (0,96 kg a.i./ha)
3. Ethrel 3 litre product/ha (1,44 kg a.i./ha).

The chemical treatments consisted of a single aeroplane swath the length of each field and 23 m wide (0,3-0,4 ha). Application was by a Grumman Super Agcat aeroplane fitted with 6 x Au 3 000 Micronair atomisers adjusted to produce drops with a volume median diameter of 300 microns. In the 19 spray irrigation fields the flight path was over an irrigation lateral so that seven rows were sprayed on each side; of these the three rows immediately adjacent to each side of the lateral were harvested experimentally. A total of 10 rows was harvested in flood irrigation fields because the cane rows were shorter than in the spray irrigation fields. A discard area, larger than the sprayed area, was left between all plots.

(*b*) Harvesting

The fields were grouped at the start of the experiment according to their expected date of harvest, so that they could be harvested over a 7 to 14 week period after each date of spraying. In practice this schedule could not be adhered to but harvest dates ranged from 6 to 15 weeks after spraying, although not in a regular manner. Experimental areas were harvested when the fields in which they were situated were harvested commercially. Of the 24 fields, three flood irrigated fields could not be harvested experimentally and of the remaining 21 fields, Field 3 was harvested with a chopper harvester. In all other fields the experimental cane was cut and topped manually, loaded mechanically, and weighed over the mill weighbridge. The mass of cane from the experiment plots was sufficient for it to be carefully identified on the mill carrier and a representative sample of the first expressed juice was obtained. This was analysed in the mill laboratory and the appropriate Java ratio used to estimate the sucrose percent cane fresh mass (s%c). An estimate of the percentage of recoverable sugar in the cane was obtained from the following equation (Anon[4]):

$$\text{ERS}\,\%\,\text{cane} = \text{Sucrose}\,\% - 0{,}485\,\text{Non sucrose}\,\% - 0{,}056\,\text{Fibre}\,\%$$

(*c*) Sampling

A random sample of 16 stalks was taken from each plot immediately before spraying, and duplicate samples per plot were taken two weeks before, and at the time of harvest. These samples were transported to Mount Edgecombe where they were completely chaffed, sub-sampled and disintegrated for the determination of moisture and sucrose contents by standard methods. This provided additional information about the response to Ethrel and served as a check on the results obtained at the mill.

TABLE 1

Sucrose and estimated recoverable sugar yield responses of individual fields (mill data)

Fields 1–12 (8 April)						Fields 13–24 (1 May)					
Field	Harvested (wks. post spraying)	Ethrel 2 ℓ		Ethrel 3 ℓ		Field	Harvested (wks. post spraying)	Ethrel 2 ℓ		Ethrel 3 ℓ	
		ts/ha	ters/ha	ts/ha	ters/ha			ts/ha	ters/ha	ts/ha	ters/ha
1	8	0,3	0,3	−0,2	−0,3	13	8	1,0	1,1	0,5	0,6
2	6	0,6	0,4	0,5	0,4	15	7	2,2	2,3	3,0	3,2
3	6	1,1	1,1	1,7	1,7	16	5,5	−0,2	−0,1	−0,2	−0,3
4	7	0,2	0,5	0,7	1,3	17	12	0,0	−0,2	1,2	1,0
5	11	1,0	1,3	0,8	1,0	18	11	0,1	0,1	0,2	0,1
6	9	0,2	0,4	1,3	1,6	19	11	1,1	1,3	0,9	1,1
7	8	1,0	1,0	−0,2	−0,3	21	14	0,3	0,3	1,0	1,4
8	9	0,7	0,6	1,0	1,0	22	14	2,4	3,0	1,4	1,7
9	10	2,1	2,3	1,6	1,9	23	14	−0,2	0,0	0,6	0,8
10	13	0,4	0,6	0,6	0,7	24	15	0,7	0,7	1,3	1,3
11	14	0,4	0,6	1,1	1,3						
Mean	—	0,73	0,83	0,81	0,94	Mean	—	0,74	0,85	0,99	1,09

TABLE 2

The average effect of Ethrel in all fields of Experiment 1

Treatment	Juice purity when sprayed	Mill data					Sample data	
		tc/ha	Purity	S % C	ts/ha*	ters/ha*	Ers % c	ters/ha*
Control . . .	78,3	130	84,7	13,2	17,0	14,4	11,8	15,2
Ethrel 2 ℓ . .		130	86,1	13,8	17,7	15,2	12,9	16,6
Ethrel 3 ℓ . .		128	86,4	13,9	17,8	15,4	12,7	16,4
Mean Response								
Ethrel 2 ℓ . .	—	—	+ 1,4†	+ 0,6††	+ 0,7	+ 0,8	+ 1,1††	+ 1,4
Ethrel 3 ℓ . .	—	—	+ 1,7†	+ 0,7††	+ 0,8	+ 1,0	+ 0,9††	+ 1,2

* Based on mean cane yield
† Statistically significant (P = 0,01)
†† Statistically significant (P = 0,001)

Experiment 2

The following 5 treatments were compared in a randomised block experiment with 5 replications:

(1) Control, not sprayed
(2) Ethrel 1 litre product/ha (0,48 kg a.i./ha)
(3) Ethrel 2 litre product/ha (0,96 kg a.i./ha)
(4) Ethrel 2 ℓ/ha + 10 kg/ha urea (46% N)
(5) Am 74/A382 1,7ℓ/ha (0,41 kg a.i./ha).

The plots were 0,6 ha in size and were sprayed on 8 April 1975, at the same time as Experiment 1, and harvested 5 weeks later. Samples of 16 stalks per plot were taken before spraying and again at harvest for analysis at Mount Edgecombe. Mass of cane per plot was recorded at the mill and juice samples were analysed as in Experiment 1.

Results

Visual effects

Ethrel and Am 74/A382 had similar, small effects on the sugarcane crop. The effect of Ethrel was not seen in all fields. The length of upper leaf laminae was reduced and there was some leaf tip scorch. Between one and three upper internodes on the topped stalk were also slightly reduced in length.

Experiment 1

The harvest results from individual fields can be expected to vary because each field contained only one plot of each treatment. Nevertheless, there was a positive response to Ethrel in 17 (81%) of the 21 fields harvested (Table 1). Samples from the three fields that were not harvested also showed a positive response. Based on mill results the average yield increase following the application of 2ℓ Ethrel per hectare was 0,7 ts/ha or 0,8 ters/ha (Table 2) and there was little further increase at the higher rate of application. The improved yield in ters/ha resulted from an increase in both juice purity and sucrose percent cane fresh mass (Table 2). The results obtained at the mill were confirmed by the samples analysed at Mount Edgecombe.

Ethrel had an effect on the yield and quality of fields sprayed in May and harvested in June/July similar to that which it had on fields sprayed in April and harvested May/June. The results indicated that fields harvested between 6 and 15 weeks after spraying did not differ in response. There was some correlation (r = −0,35) between the response to Ethrel in individual fields and the purity of the juice at the time of spraying, taken as a measure of the maturity of the crop.

Experiment 2

The data were adjusted before analysis to overcome differences among plots that were present before the treatments were applied. Both Ethrel and Am 74/A382 had a positive ripening effect and increased ers % c (Table 3). There was an indication that Ethrel increased cane yield but this increase was not statistically significant. Mill data indicated no response in ers % at the high rate of Ethrel application but this was not confirmed by sample data. The addition of urea to Ethrel had no effect.

TABLE 3
Adjusted harvest data for Experiment 2

Treatment	Mill Data			Sample Data
	tc/ha	Ers % c	Ters/ha*	Ers % c
Control	128	9,6	13,0	10,3
Ethrel 1 ℓ	140	10,6	14,4	11,2
Ethrel 2 ℓ	146	9,9	13,4	10,9
Ethrel 1 ℓ + urea	140	10,1	13,8	10,9
Am 74/A382 1,7ℓ	128	10,4	14,2	11,1
Mean	136	10,1	14,8	10,9
L.S.D. (0,05)	18,6	0,6	—	0,8
(0,01)	25,6	0,9	—	1,0
C of V (%)	10,2	4,8	—	5,1

* Based on mean cane yield.

Discussion

In commercial sugarcane fields in Experiment 1, Ethrel produced substantial average improvements in sucrose percentage, juice purity and the yield of estimated recoverable sugar (ters/ha) of irrigated sugarcane harvested at 12-14 months of age. There was a yield increase of 0,7 ton sucrose per hectare or 0,8 ters/ha following the application of 2ℓ Ethrel (48% m.v.) per hectare, with little further response at a rate of 3ℓ Ethrel per hectare. These results imply that an economically significant yield response might have been obtained at a lower rate of application and this was confirmed in Experiment 2 in which there was a yield response of 1,4 ters/ha to 1ℓ Ethrel per hectare with no further increase at 2ℓ Ethrel per hectare. Similar good yield responses to 1ℓ Ethrel per hectare were also obtained in two experiments carried out by Messrs. Agricura in the Eastern Transvaal in 1974 and in one trial in Swaziland in 1975 (Engelbrecht, personal communication). The new product Am 74/A382 also had a good ripening effect similar to that of Ethrel and deserves further testing.

The lack of response to Ethrel at high rates of application differs from the results previously reported by Rostron,[2, 3] possibly because of differences in the condition of the crop at the time of spraying, determined by such factors as its age and natural maturity. The natural maturity of the crop during the first three months of the 1975 milling season at Ubombo Ranches was higher than usual (Crookes, personal communication), with juice purities in Experiment 1 ranging from 68 to 84% in April. It is possible that under these conditions Ethrel at a lower rate of application will be sufficient for a good ripening response, although an increased response at higher rates of application has been reported for other crops and in other years. Further experimentation, possibly involving more basic studies, will be necessary in order to determine more precisely the optimum rate of Ethrel application for given sugarcane crop.

In earlier work, a good correlation was demonstrated between the juice purity at the time of spraying and the yield response to Ethrel (Rostron[3]). There was some support for this relationship in Experiment 1, although the correlation was rather poor ($r = -0,35$), probably due to the lack of replication within fields and the limited range of initial juice purities.

Ethrel was equally effective during the first three months of the milling season and it is possible, therefore, that there might have been some response to the chemical had it been applied even later in the milling season. The apparent lack of response in some fields may simply have been because of the lack of replication in individual fields and an unfortunate choice of the experimental area.

The amount of time that can elapse between spraying and harvesting, without the effect of Ethrel being lost, is important from a practical point of view. The results reported here indicate that fields that will be harvested over a 6-12 week period can be sprayed at the same time. This leads to an efficient use of contract spray equipment.

The results reported in this paper confirm the ripening effect of Ethrel on sugarcane *cv* NCo 376. The use of the chemical may be justified where the natural maturity of the crop is low and presents a problem in the manufacturing process. Under these conditions substantial improvements in sugar yield and cane quality will result from the use of Ethrel.

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