COMMERCIAL EXPERIENCE WITH CHEMICAL SUGARCANE RIPENERS AT SIMUNYE SUGAR ESTATE IN SWAZILAND

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Abstract

The results of five years of commercially ripening sugarcane, mainly variety NCo 376, are presented and discussed. The ripeners were Ethrel (ethephon), Polado (glyphosate) and Fusilade Super (fluazifop-butyl). Extensive assessments confirmed the consistency and effectiveness of Ethrel in ripening variety NCo 376, with positive responses in all years, from May to October, averaging 0,7 units of pol % cane and 1,0 t pol ha^{-1}. Polado was used mainly on late harvested cane, increasing pol % cane and t pol ha^{-1} by about 0,6 and 0,4 units respectively. Fusilade Super gave disappointing results at the recommended rate of 0,3 ℓ ha^{-1}, but at 0,42 ℓ ha^{-1} it has apparently outperformed Polado, though not Ethrel. Combining both Ethrel and Fusilade, the so-called 'piggy-back' treatment, produced excellent results on variety NCo 376 in 1986, increasing pol % cane, t pol ha^{-1} and purity % cane by 1,3, 1,4 and 2,0 units respectively. These results indicate that each ripener acts independently and that the individual benefits are additive.

Introduction

Much trial work has been done on the artificial ripening of sugarcane in southern Africa which shows that marked responses in quality and sucrose yields may be obtained when ripeners are used correctly (Rostron[4, 5, 8, 9]). However, doubt is often expressed as to whether these trial responses can be realised in the field. Even among the considerable number of estates and growers who do use ripeners there is often uncertainty as to what responses are actually being achieved.

Observed ripener responses are affected by many factors such as topping height, maturity, and crop condition at application, as well as the cane variety and choice of ripener. But Rostron (unpublished data) concludes that all ripeners when used correctly on a well grown crop will give responses of similar magnitude, ie about 1 t sucrose ha^{-1}. In the commercial context, however, it is generally very difficult to evaluate meaningfully responses, owing to inherent field variability and too few field comparisons.

Simunye Sugar Estate in north eastern Swaziland is particularly well suited to assess commercial ripener responses because of its size and having a single harvest front which cuts on average two fields (about 50 ha) a day, in small groups. These groups received various ripener treatments, and 5 years of commercial comparisons are presented in this paper.

Simunye has 9 200 ha of well grown irrigated cane, confirmed by the 1986 cane yield of 131 t ha^{-1} (11,0 t ha^{-1} mth^{-1}). Eighty percent is under overhead irrigation with the remainder furrow irrigated. The crop is harvested annually at about 12 months of age, with NCo 376 the main variety comprising 80 % of the crop. The area being planted to the promising new variety N14, which accounts for the bulk of the remaining 20 % is increasing. The estate is newly developed, and has only been in full production since 1982. Geographical situation and climatic data may be found in Appendix 1.

The emphasis of this paper is on actual commercial responses obtained in the field to ripeners over the past five years, largely on variety NCo 376. The ripeners considered are Ethrel (ethephon 48 % ai), Fusilade Super (fluazifop-butyl, 12,5 % ai), and Polado (glyphosate, 75 % ai), as well as a combined application of Ethrel followed by Fusilade Super, the so-called 'piggy-back' treatment.

Method

Integral groups of uniformly treated fields received various ripening treatments, were harvested sequentially, and the yield data collated over a five year period. Treatments were allocated with the emphasis on practical considerations such as ease of aerial application, and there may have been as few as two or as many as fifteen fields in each comparison group. For example, a group of five fields might have had two treated with Ethrel, two with Fusilade Super and one kept as an untreated control. Controls, however, were kept to a minimum, and comparison groups frequently compared one ripener treatment to another, without any untreated control fields.

Table 1

Commercial ripener treatments at Simunye

Ripener	Rate per ha	Timing - weeks before harvest
Ethrel (E) (ethephon, 48 % ai)	1.5 ℓ up to 1984 1.35 ℓ + 1 % Downrite from 1985	10–12 wks April to July harvest. 16–28 wks Aug–Oct harvest*
Fusilade Super (FS) (fluazifop-butyl 12,5 % ai)	NCo 376: 0,3 ℓ 1984/85 0,42 ℓ in 1986 N14 : 0,3 ℓ in 1984–85 0,42 ℓ to Sept. 86 0,60 ℓ from Oct. 86	6–10 weeks Shorter period in warmer months Longer period in cooler months
Polado (P) (glyphosate, 75 % ai)	0,5 kg	As for Fusilade Super.
Ethrel + Fusilade 'Piggy-back' (PB)	As for E & FS	As above

1 % Downrite oil used in all treatments from 1985
* last spray end April

The area ripened has increased annually, reaching 70% in 1986 which realised a return of about 6 400 t sugar.

Treatments. Table 1 summarises the ripener treatments.

Rates have changed with experience. Ethrel was initially applied at 1,5 ℓ ha^{-1} but trial evidence that the addition of Downrite oil to a concentration of 1 % substantially improved overall recoveries led to a rate of 1,35 ℓ ha^{-1} + 1 % Downrite being applied. This has been the rate of Ethrel used since 1985.

The recommended rate for Fusilade Super of 0,3 ℓ ha^{-1} was used in 1984 and 1985, but on the evidence of Swaziland Sugar Association trials (unpublished data) this was increased to 0,42 ℓ ha^{-1} in 1986, and later to 0,6 ℓ ha^{-1} for variety N14 effective from October 1986 harvested cane.

A wide range of timing may be used for Ethrel, which achieves full affect after 6 to 8 weeks in the early season and holds it for many weeks thereafter (Sweet,[10] Rostron[4,7]). The only constraint is that it should be applied no later than late April or early May in order to avoid application in cold weather which could affect the response. Timing for Fusilade Super and Polado, however, is more critical and varies with the time of year. There is an optimum harvest range of only 3 to 4 weeks, and further delay may result in yield losses (Rostron[8]).

Ripeners were not applied in conditions of high wind and evaporation, and they were withheld from fields that were excessively stressed, flowered, lodged or eldana-damaged.

Harvesting. This used to be by both chopper harvester, and by hand cutting and continuous loader, both systems feeding billeted cane into tractor drawn bins which are delivered to the mill within 12 hours. Hand-cutting, however, has been the only system since 1984. Four cane lines are cut and windrowed and topped together. Fields are burnt the day before cutting, cut in one day, and loaded the following day.

Yield Assessment. Yield and quality figures were obtained in the normal commercial manner, based on mill weighbridge and laboratory results. Yields were corrected to twelve month old equivalent. On average, about one sample was analysed per 40 t cane.

Results and Discussion

Ethrel

This ripener has been used the longest and most extensively on this estate, largely on variety NCo 376. The results are presented in Table 2 and cover the 5 years from 1982 to 1986, from May to October.

Ethrel on variety NCo 376. The large number of comparisons made over a 5 year period make this the most comprehensive and conclusive assessments of the commercial ripener. Table 2 lists the results as monthly averages, with the overall annual and monthly means weighted for the number of comparisons.

The body of the table and the standard deviations reflect the wide inherent field to field variability in cane yield, but the overall mean confirms that cane yields were not adversely affected by Ethrel, in keeping with the results of much trial data (7,12). In fact, the data suggest that the yields of cane cut in October may even be enhanced, but this observation requires ratification.

Accepting that cane yields were not materially affected by Ethrel, then pol % cane may be taken as the measure of response. This was positive in every month from May to October, in all 5 years, with an overall mean response of 0,67 % units of pol % cane. This translated into 1,00 t ha^{-1} of pol (Table 2).

The best quality response occurred in May, which could be expected as it is the month with the lowest quality in the milling season. From June to early October the pol % cane

Table 2

Commercial response of variety NCo 376 to Ethrel over 5 years at Simunye.
Number of comparisons given in bracket

Month of Harv.	Yield response t/ha/12 months																		S.D.		
	1982			1983			1984			1985			1986			Weighted Mean					
	Cane (t c ha^{-1})	Pol %	Pol (t suc ha^{-1})	Cane (t c ha^{-1})	Pol %	Pol (t suc ha^{-1})	Cane (t c ha^{-1})	Pol %	Pol (t suc ha^{-1})	Cane (t c ha^{-1})	Pol %	Pol (t suc ha^{-1})	Cane (t c ha^{-1})	Pol %	Pol (t suc ha^{-1})	Cane (t c ha^{-1})	Pol %	Pol (t suc ha^{-1})	Cane (t c ha^{-1})	Pol %	Pol (t suc ha^{-1})
May		-		−2	+1,34 (3)	+1,56	+1	+1,26 (2)	+1,64	+2	+0,71 (4)	+1,17	−1	+0,69 (5)	+0,86	0	+0,92 (14)	+1,21	6,0	0,54	0,92
June	+1	+0,60 (2)	+0,78	+13	+1,10 (1)	+2,64	−2	+0,39 (2)	+0,24	−17	+0,04 (1)	−3,00	−3	+0,68 (8)	+0,64	−2	+0,63 (14)	+0,49	9,5	0,42	1,62
July	+6	+0,58 (3)	+1,40	+10	+0,90 (4)	+2,88	+9	+0,76 (3)	+1,52	−26	+1,32 (1)	−1,44	−1	+0,36 (5)	+0,36	+3	+0,67 (16)	+1,30	12,9	0,51	1,93
Aug.	−2	+0,74 (2)	+0.48	+7	+0,57 (3)	+1,60	+8	+0,60 (3)	+1,72	−3	+0,55 (4)	+0,33	−6	+0,20 (2)	−0,61	+1	+0,54 (14)	+0,78	10,1	0,45	1,43
Sept.	−9	+0,87 (1)	+0,24	+29	+0,70 (1)	+4,44	−7	+0,43 (1)	+0,36	−10	+0,51 (4)	−0,81	0	+0,84 (5)	+1,04	−3	+0,69 (12)	+0,95	20,5	0,40	2,56
Oct.		-			-		+15	+0,85 (4)	+1,20	+5	+0,20 (3)	+1,16	+2	+0,69 (2)	+1,36	+8	+0,59 (9)	+1,25	8,0	0,52	1,50
Weight Mean	+1	+0,69 (8)	+0,94	+8	+0,93 (12)	+2,26	+7	+0,74 (15)	+1,21	−4	+0,53 (17)	+0,11	−1	+0,62 (27)	+0,67	+1	+0,67 (79)	+1,00	12,1	0,48	1,70
S.D.	8.5	0.40	1,14	13.6	0,54	1,94	8,5	0,53	1,37	11,3	0,46	1,42	13.0	0,44	1,84	12,1	0,48	1,70			

response level did not decrease markedly as the natural peak period of October/November was approached, suggesting that responses might be obtained even in November and December. Zero or negative responses have hitherto been recorded for Ethrel for late season cane (Rostron[7]), but the Ethrel was applied about 8 weeks before harvest when the cane was relatively mature. It is possible that by applying Ethrel at the end of April, as much as 24 weeks before harvest, positive ripening benefits might be obtained throughout the entire milling season. Split applications as discussed by Rostron[6] might help to achieve this, although to date there have been no observed benefits to splitting the application at Simunye. An added advantage would be that Ethrel would prevent flower emergence, if not initiation, which would benefit both field and mill operations in years when flowering was severe.

The results are remarkable for their consistency considering the wide-ranging conditions experienced over these 5 years. Only in 1985 were mean responses low, but they were still positive. This consistency of response in nearly 80 comparisons makes it safe to conclude that Ethrel works well on well grown NCo 376 over a wide range of conditions, and that the benefits are realised commercially, confirming the trial results of Rostron,[7] Rostron *et al*[5] and Sweet.[10]

It is possible that the lower response in 1985 may have been, at least in part, due to the reduced application rate, but the 1986 results do not bear this out. However, there is the possibility that better responses might have been obtained in these two years had Ethrel been applied at 1,5 ℓ ha^{-1} rather than 1,35 ℓ ha^{-1}.

Ethrel on variety N14. There have been only four commercial comparisons with this new variety, too few to be of any significance, and with rather variable results. Estate small plot trials together with trials by the Swaziland Sugar Association (unpublished data) indicate that N14 does not respond as well or as consistently to Ethrel as does NCo 376. Further work is required to confirm this.

Split applications of Ethrel. Rostron[6] found benefits from splitting Ethrel into two equal applications, the response apparently holding for longer into the season. At Simunye 8 split applications were made 4 to 5 weeks apart on variety NCo 376, the second application being at the end of April. These were compared with a single full rate application at the end of April and the responses are listed in Table 3. These show no benefit to split applications, but with only a few comparisons this needs confirmation.

Table 3

Commercial response of variety NCo 376 to split application compared with single applications of Ethrel on NCo 376

Comparisons	Month and year of harvest	Response t/ha/12 months		
		Cane (t c ha^{-1})	Pol %	Pol (t suc ha^{-1})
5	10.84	−1	−0,09	+0,48
3	10/85	−10	+0,21	−1,16
Mean		−4	+0,14	−0,14

Polado

Commercial application on variety NCo 376 was largely at the end of the milling season, Ethrel being considered safer and more effective in early and mid-season. Commercial results for three years are listed in Table 4. These show a positive quality response for each assessment month, averaging 0,57 units of pol % over 13 comparisons. Cane yield results were variable and of questionable significance, but it is interesting to note the apparent positive responses in 1982 and negative responses in 1983 and 1984. The overall mean pol yield response was 0,37 t ha^{-1}.

There were no commercial comparisons with variety N14, although estate small plot trials indicated that Polado worked well on N14 early in the season. It also outperformed Ethrel on variety N52/219 in the early season, but this variety was discontinued in 1984.

Polado used to have a useful place in Simunye's ripening programme, but there was considerable unresolved concern about its effect on ratoon regrowth, which exhibited marked chlorosis in the young ratoon on a number of occasions. This may have been the result of the crop being stressed at the time of application, and yields may not have been affected. However, despite evidence that ratoon regrowth is effected only if the crop is stressed at or after application (Donaldson,[1] Donaldson and Inman-Bamber[2]), the opinion on the estate, supported by observations and some literature (Rice *et al*[3]) was that Polado could be a potential danger to the succeeding ratoon especially if the cane was stressed before harvest.

Fusilade Super has now replaced Polado completely at Simunye, being cheaper, apparently safer and equally effective (Rostron[8] and Rostron *et al*[9]). No ratoon chlorosis has been observed following the use of Fusilade Super.

Table 4

Commercial response of late season variety NCo 376 to Polado. Number of comparisons in brackets

Month of Harv.	Yield response t/ha/12 months											
	1982			1983			1984			Mean		
	Cane (t c ha^{-1})	Pol %	Pol (t suc ha^{-1})	Cane (t c ha^{-1})	Pol %	Pol (t suc ha^{-1})	Cane (t c ha^{-1})	Pol %	Pol (t suc ha^{-1})	Cane (t c ha^{-1})	Pol %	Pol (t suc ha^{-1})
Oct.	+13	+0,45 (2)	+2,1	−9	+0,70 (3)	−0,36	−10	+0,27 (1)	−1,20	−2	+0,55 (6)	+0,32
Nov.	+5	+0,15 (3)	+1,08	−9	+0,67 (3)	−0,60	−3	+1,61 (1)	+1,44	−2	+0,58 (7)	+0,41
Mean	+8	+0,27 (5)	+1,49	−9	+0,69 (6)	−0,48	−7	+0,94 (2)	+0,12	−2	+0,57 (13)	+0,37

Fusilade Super

This ripener was first used at Simunye in December 1983. The results of this and other trials with Fusilade Super were reported in 1985[8] and were very promising, outperforming both Ethrel and Polado and showed no effects on ratoon regrowth even when applied at very high rates. More recent trials in South Africa on variety NCo 376 (Rostron *et al*[9]) lists responses of 1,0 units of ers % cane and 0,8 t ers ha^{-1}.

Fusilade Super was first used commercially on this estate in the late season of 1984 at the recommended rate of 0,3 ℓ ha^{-1} (38 g ai). However, the commercial results for variety NCo 376 for the 1984 and 1985 seasons were disappointing, with only a minimal quality benefit and no pol yield benefit (Table 5). In 1986, based on trials by the Swaziland Sugar Association (unpublished data), the rate was increased to 0,42 ℓ ha^{-1}, and this is assumed to be the main reason for the much improved results in 1986 (Table 5). These were still lower than expected and not as good as with Ethrel, although better than with Polado.

Responses to Fusilade Super on variety NCo 376 have not matched trial results, even at the increased application rate. The reasons are not obvious, although pre-harvest drying off may have been excessive at times, especially in the November 1986 comparisons when exceptionally high evaporations were recorded. This could have affected response levels.

Combined Ethrel and Fusilade Super ('Piggy-back'): 1986

Rostron[8] found statistically significant improvements in quality and sucrose yield to Fusilade Super when applied to cane that had already been treated with Ethrel. This showed that the effects of the two ripeners might be additive. To test this a few commercial comparisons were done in early 1986 on variety NCo 376, each ripener being applied at full rates and at the normal times before harvest.

The results proved to be so promising that many more comparisons were made, Fusilade Super being applied to fields of NCo 376 originally scheduled for Ethrel treatment only. The results are presented in Table 6, in two groups. The first shows the 'piggy-back' response compared with unripened control, ie, the combined response of the two ripeners. The second shows the response of 'piggy-back' compared with Ethrel alone, ie, the additional response to Fusilade Super over and above that of Ethrel.

Responses were very marked in both groups. 'Piggy-back' treatments gave positive quality responses in every one of the 22 comparisons with control for an average increase of 1,20 units of pol % cane, and in all but two of the 29 comparisons with Ethrel, averaging 0,53 units of pol % increase. Cane yields were inevitably much more variable, but the quality benefit of the pol yield, registered an average increase of 1,03 t ha^{-1} compared with the control and 0,32 t ha^{-1} compared with Ethrel.

Cane yields in fields harvested in September appeared to be reduced appreciably, resulting in negative effects on pol yield, despite large improvements in pol % cane. The significance of these results is not apparent. Excluding the September data from the overall mean had little effect on pol % cane response, but it increased the mean pol response by some 0,3 t ha^{-1} (Table 6).

Unfortunately there were only four comparison groups that included all three ripener treatments as well as a control, which is too few for any meaningful evaluation to be made as to whether the response to 'piggy-back' was the sum of the responses to Ethrel and Fusilade Super alone. However, although there were only six comparisons with Fusilade Super

Table 5

Commercial responses of variety NCo 376 to Fusilade Super. Number of comparisons in brackets

Month of Harv.	Yield response t/ha/12 months														
	0,30 ℓ/ha rate									0,42 ℓ/ha rate			Mean		
	1984			1985			Mean			1986					
	Cane (t c ha^{-1})	Pol %	Pol (t suc ha^{-1})	Cane (t c ha^{-1})	Pol %	Pol (t suc ha^{-1})	Cane (t c ha^{-1})	Pol %	Pol (t suc ha^{-1})	Cane (t c ha^{-1})	Pol %	Pol (t suc ha^{-1})	Cane (t c ha^{-1})	Pol %	Pol (t suc ha^{-1})
May		-		−5	−0,53 (2)	−0,10	−2	−0,53 (2)	−0,10	−3	+1,09 (3)	+1,15	−4	+0,44 (5)	+0,65
June		-		−5	+0,51 (3)	+0,01	−5	+0,51 (3)	+0,10	−10	+0,50 (1)	−1,14	−6	+0,51 (4)	−0,28
July		-		−4	+0,24 (4)	0	−4	+0,24 (4)	0		-		−4	+0,24 (4)	0
Oct.		-		−1	+0,49 (1)	+0,03	−1	+0,49 (1)	+0,03		-		−1	+0,49 (1)	+0,03
Nov.	−4	+0,32 (2)	−0,18	−2	−0,06 (3)	−0,02	−3	+0,04 (5)	−0,06	+3	+0,01 (2)	+0,40	−1	+0,07 (7)	+0,05
Dec.	0	+0,99 (1)	+0,36		-		0	+0,99 (1)	+0,36		-		0	+0,99 (1)	+0,36
Mean	−1	+0,54 (3)	0	−4	+0,13 (13)	−0,01	−3	+0,19 (16)	−0,01	−2	+0,63 (6)	+0,52	−3	+0,32 (22)	+0,13

Note: There were no comparisons in August or September.

on its own in 1986 (Table 5), there were 27 comparisons with Ethrel on its own (Table 2). The means of these two sets of results were added together (Table 7) and compared to actual 'piggy-back' responses, excluding the questionable figures of the cane harvested in September.

The two sets of figures are remarkably similar, which is a strong indication that each ripener worked independently and that the overall response was the sum of the individual responses.

The question arises as to whether the same response levels can be achieved by applying both ripeners together at the same time, or whether this would check growth excessively. The benefits of Ethrel may need to be realised (about 6 weeks after application) before Fusilade is applied in order to realise the 'piggy-back' response.

When comparing 'piggy-back' with Ethrel results (Table 6, section 2), it is apparent that the mean monthly pol % cane response to Fusilade Super over and above that of

Table 6

Commercial response of variety NCo 376 to combined Ethrel and Fusilade Super 'piggy-back' treatment in 1986

Month of Harvest	Yield response t/ha/12 months							
	1. 'Piggy-back' vs Control				2. 'Piggy-back' vs Ethrel			
	Comparison	Cane (t c ha^{-1})	Pol %	Pol (t suc ha^{-1})	Comparison	Cane (t c ha^{-1})	Pol %	Pol (t suc ha^{-1})
May	1	−23	+1,93	−0,57	1	−7	+0,97	+0,30
	2	13	+1,17	+3,21	2	+17	+1,17	−0,86
	3	−7	+2,05	+2,02	3	+11	+0,25	+1,76
	4	−3	+1,10	+1,03	4	−7	+0,81	+0,19
					5	+7	+0,80	+1,93
	Mean	−5	+1,56	+1,42	Mean	+4	+0,80	+0,66
June	1	−21	+0,87	−1,63	1	−10	+0,43	−0,73
	2	−6	+2,36	+2,97	2	−4	+0,79	+0,80
	3	+9	+1,36	+2,79	3	−3	+0,84	+0,63
	4	−2	+1,88	+2,64	4	−5	+0,98	+0,87
	5	−13	+1,29	+0,28	5	+11	+0,41	+2,02
					6	−4	+0,39	−0,03
	Mean	−7	+1,55	+1,41	Mean	−3	+0,64	+0,59
July	1	−8	+0,29	−0,71	1	−20	+1,13	−1,54
	2	+11	+0,40	+2,10	2	−6	+0,11	−0,72
	3	+14	+1,16	+3,20	3	+11	+0,33	+1,99
	4	−2	+1,45	+1,78	4	+1	+0,34	+0,45
					5	+5	+0,58	+1,46
	Mean	+4	+0,83	+1,59	Mean	−2	+0,50	+0,33
August	1	−13	+1,04	−0,31	1	+9	−0,09	+1,12
	2	0	+0,52	+0,68	2	−5	+0,91	+0,56
					3	+4	+0,67	+1,33
					4	+4	+0,25	+0,89
	Mean	−7	+0,78	+0,19	Mean	+3	+0,44	+0,98
September	1	−21	+1,64	−0,78	1	−8	+0,92	−0,02
	2	−16	* +1,06	−1,07	2	−1	−0,56	−0,84
	3	−10	+1,27	+0,15	3	0	+0,65	+0,92
	4	+9	+0,27	+1,64	4	−20	+0,31	−2,55
	5	−17	+1,39	−0,70	5	−32	+0,05	−4,60
					6	+8	+0,71	+1,88
	Mean	−11	+1,13	−0,15	Mean	−9	+0,35	−0,87
October	1	−5	+1,09	+0,68	1	−3	+0,53	+0,23
	2	+16	+0,81	+3,21	2	−3	+0,40	+0,07
					3	+10	+0,13	+1,68
	Mean	+6	+0,95	+1,95	Mean	+1	+0,35	+0,66
Overall mean	22	−4	+1,20	+1,03	29	−1	+0,53	+0,32
S.D.		12	0,56	1,60		11	0,39	1,47
Mean (excluding September)	17	−2	+1,28	+1,37	23	+1	+0,57	+0,62
S.D.		12	0,58	1,57		9	0,35	0,98

Table 7

Mean commercial response of variety NCo 376 in 1986 to Ethrel & Fusilade Super, individually and in 'Piggy-back' combination

Comparisons	Number of Comparisons	Mean response t/ha/12 months		
		Cane (t c ha^{-1})	Pol %	Pol (t suc ha^{-1})
Fusilade Super alone	6	−2	+0,63	+0,52
Ethrel alone	27	−1	+0,62	+0,67
Total Ethrel and Fusilade Super 'piggy-back' combination*	17	−3 −2	+1,25 +1,28	+1,19 +1,37

*Excludes September figures.

Ethrel was at its highest of 0,8 units in May and declined each month to 0,35 units in September and October. There were insufficient results for Fusilade Super on its own (Table 5) to confirm this trend, but it is to be expected that quality responses to ripeners will decrease as the natural peak in quality is approached. This is usually about late October to early November.

The large number of comparisons and marked responses to 'piggy-back' treatment give credibility to the abovementioned conclusions. But it must be remembered that these reflect only one year's results on one estate and on one variety, NCo 376. There were too few comparisons with variety N14 to allow any meaningful assessments.

Purity

Purity % cane figures (Table 8) are available only for 1986. They show that on average Ethrel and Fusilade Super increased purities of variety NCo 376 by 1,2 and 1,0 units respectively. These increases are similar, but considerably less than the 2,0 units achieved with the 'piggy-back' treatment.

Surprisingly, natural purities varied little through the season except for the months of June and August, when the respectively low and high levels presumably accounted for the particularly high and low responses. However, there was a distinct trend to high responses early in the season, dropping markedly in July and August, then increasing again in September and October. No trend was evidenced with Fusilade Super, for which there were too few comparisons.

It is well established that ripeners improve purities (Rostron *et al*,[5,8] Rostron,[7] Sweet[10]), but the observed pattern of response needs verification. The high responses in June suggest that responses are greatest when natural purities are low, as might be expected. The marked improvement of purity in the early season, associated with increased pol % cane, would benefit mill operations in this normally low quality period, especially with 'piggy-back' treatment which increased pol % by 1,55 units and purity % by about 3 units.

Eldana

Estate eldana surveys indicate that ripeners may increase eldana levels, which would reduce potential ripening benefits. If this were true, the effect must be slight since such marked responses have been achieved. However, there is the possibility that increasing use of ripeners and 'piggy-back' in particular could raise the overall levels of eldana. This warrants investigation, although eldana levels have not increased at Simunye over the past 5 years with increasing ripener use.

Table 8

Effects of ripeners on purity % cane of variety NCo 376 in 1986 No. of comparisons given in brackets

Month of Harvest	Response – purity % cane			Mean purity % of controls
	E : C	FS : C	PB : C	
May	+1,1 (5)	+1,0 (3)	+2,4 (4)	84,0
June	+2,4 (8)	+0,8 (1)	+3,7 (5)	81,4
July	+0,1 (5)	-	+0,9 (4)	84,1
August	−1,0 (2)	-	−0,2 (2)	86,1
September	+1,4 (5)	-	+1,9 (2)	84,3
October	+1,6 (2)	-	+1,8 (2)	83,4
November	-	+1,10 (2)	-	84,0
Weighted Mean	+1,2 (27)	+1,0 (6)	+2,0 (22)	83,5

E = Ethrel
FS = Fusilade Super
PB = 'piggy-back' combination of E + FS
C = Untreated control

Conclusions

Ripeners have been very successfully used on the estate over the past 5 years, with marked responses being obtained when used correctly on well grown cane.

The system of commercial field comparisons used appears to be a very useful and reliable method of evaluating responses to cane ripeners in the commercial context. These have been as expected for Ethrel, though somewhat lower for Fusilade Super.

Ethrel has proved to be a consistently safe and reliable ripener on well grown variety NCo 376 in all five assessment years, with an average response of 0,7 units of pol % cane, 1,0 t suc ha^{-1} and with no effect on cane yield. Quality increases were highest in May, but otherwise held from June to October, pointing to the possibility of positive responses throughout the harvest season, into November and early December.

Polado worked well on variety NCo 376, but sometimes affected the following ratoon regrowth and has been replaced by Fusilade Super on the estate.

Fusilade Super was introduced in 1984, and at the recommended rate of 0,3 ℓ ha^{-1} gave disappointing results on variety NCo 376. Increasing the rate to 0,42 ℓ ha^{-1} appears to have improved the response considerably, to about 0,6 units of pol % cane and 0,56 t suc ha^{-1} which is still less than with Ethrel. There were indications that Fusilade Super does not work well on cane harvested in September and that the pol % cane response peaks in May and declines through the season therafter.

Combining Ethrel and Fusilade into the so-called 'piggy-back' treatment gave exceptional responses on variety NCo 376. These were 1,3 units of pol % cane and 1,4 t pol

ha^{-1}, if the poor Fusilade response month of September is excluded. The evidence points strongly to the two ripeners acting independently of each other and to their individual benefits being additive.

Comparison data with variety N14 are too few to allow any meaningful evaluations, but the indications are that it responds to Ethrel less favourably than variety NCo 376.

On average ripeners improved purity % cane by about 1 unit with Ethrel and Fusilade Super, and about 2 units with 'piggy-back' treatment. But there was a trend towards high responses in the early and late season, with slight to negative responses in July and August.

Acknowledgements

Our thanks go to estate field staff for their help and co-operation, and to H Rostron for useful suggestions in the preparation of this paper.

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APPENDIX I

Climatic and location data for Simunye Sugar Estate

Location	26° S, 32° E
Altitude (m)	200
Annual rainfall (mm)	800
Temperature - mean daily (°C)	21.5 (15.0–28.0)
Mean monthly evaporation (mm)	167 (100–210)
Sunshine hours d^{-1}	7.1
MJ m^{-2} d^{-1}	18