THE RESPONSE OF SUGARCANE VARIETIES TO CHEMICAL RIPENERS IN THE NATAL MIDLANDS

By H. ROSTRON

(ICI Agrochemicals, Farmers Organisation Division, P O Box 1285, Verulam 4340, Rep. of South Africa)

Abstract

Five sugarcane varieties were grown under irrigation in the Umgeni valley and harvested annually following treatment with chemical ripeners in three consecutive seasons.

Three ripeners, Ethrel (ethephon, 480 g ai/ℓ), Fusilade Super (fluazifop-p-butyl, 125 g ai/ℓ) and Polado (glyphosate, 750 g ai/ℓ) were applied in March each year and samples were taken to monitor changes in cane quality until the crops were harvested in June.

In all years, all ripeners improved cane quality and sugar yield by similar amounts in all varieties except N11, which responded to ripeners in one year only. In the other two years the quality of N11 was better than that of the other varieties and it produced higher sugar yields. The reasons for the better quality and the erratic response of N11 to chemical ripening could not be determined.

Introduction

An experimental site was established in 1982 in the Umgeni valley, near Wartburg in the Natal midlands, by staff of the Noodsberg Sugar Company Limited. Five varieties were planted under irrigation on the farm "Settle" to determine whether sugarcane would grow quickly enough, under the hot summer conditions in this valley, to permit annual harvesting in June, so avoiding the dangers of frost often experienced in winter.

Between 1984 and 1986 three experiments were undertaken, in which chemical ripener treatments were superimposed on the varieties shortly before harvest. Standard rates of Ethrel, (ethephon, 408 g ai/ℓ), Fusilade Super (fluazifopp-butyl, 125 g ai/ℓ) and Polado (glyphosate, 750 g ai/ℓ) were tested in the first two years, and in the third year the Polado treatment was replaced by a second rate of Fusilade Super.

Materials and Methods

The experiment was a randomised block design with three replicates. The main plots were varieties which were split so that each of four ripener treatments could be applied to six rows of sugarcane spaced one meter apart. The ripener treatments were re-randomised each year. Main plots were 315 m^2 in area and subplots were 135 m^2 gross and 74 m^2 net in size. The soil was a Westleigh form (Sibasa series) with more than 35% clay in the subsoil and irrigation supplemented rainfall to maintain good growth throughout the life of the crop.

The varieties were NCo376, NCo293, N11, N12 and N13 and they were sprayed with ripeners in March at 9 months of age, and harvested in June each year. Ethrel was applied at a rate of 720 g ai/ha (1,5 ℓ/ha product), and Fusilade Super at 37,5 g ai/ha (300 ml/ha product) in each year. In 1984 and 1985 Polado was applied at 375 g ai/ha (500 g/ha product) but in 1986 this treatment was replaced by a second rate of 56 g ai/ha (450 ml/ha) of Fusilade Super. Treatments were applied with a CO_2 pressurised sprayer with an overhead boom fitted with two TK 1,5 nozzles spaced 3,1 m apart and pointing upwards and backwards. A swath of 6 m was sprayed and the rate of application ranged between 67 and 79 ℓ/ha.

Samples of 16 stalks per subplot were taken at irregular intervals between the times of spraying and harvest. They were trashed and topped either at the natural breaking point, or where Fusilade Super had produced a blackened ring on the stalk. To determine treatment effects the samples were analysed by staff of the Experiment Station of the South African Sugar Association at Mount Edgecombe. In 1984 and 1986 net plots were harvested and massed with a tractor-mounted electronic scale. In 1985 lodging prevented accurate harvesting, and yield per plot was estimated from sam-

Table 1

Summary of harvest data for three years

	Tons cane/ha			ERS % cane			Tons ers/ha		
	1984	1985	1986	1984	1985	1986	1984	1985	1986
Variety									
NCo376	134	90	110	6,2A	6,2A	9,9AB	8,3A	5,5A	10,9AB
NCo293	122	75	104	6,7A	5,8A	8,9B	8,2A	4,4A	9,2BC
N11	122	72	104	9,5B	9,2B	10,9A	11,5B	7,2B	11,6A
N12	126	74	121	5,9A	6,5A	9,7AB	7,4A	4,8A	11,8A
N13	144	84	118	4,5C	4,5C	7,4C	6,4A	3,8A	8,8C
Ripener									
Control	129	77	112	5,6	5,8	8,3	7,2	4,4	9,3
Ethrel	134	83	113	6,7*	7,2**	9,1*	8,9*	5,9**	10,2
Polado	129	79	-	6,9**	6,4	—	8,7*	5,0*	-
Fusilade 300	126	80	116	7,0**	6,4	9,9**	8,6*	5,1*	11,6**
Fusilade 450	-	-	105	-	-	10,1**	-	-	10,5*
Mean	130	80	112	6,6	6,5	9,4	8,3	5,1	10,4

* Statistically significant at the 5% probability level
** Statistically significant at the 1% probability level

Varieties with the same letter do not differ significantly from one another.

ple mass per stalk and standard numbers of stalks per hectare, which were different for each variety.

Results

1. Varieties

There were no statistically significant differences in cane yield amongst varieties in any year, but significant differences in cane quality resulted in appreciable differences in the yield of estimated recoverable sugar per hectare (ters/ha) in each year (Table 1). Variety N11 consistently produced more sucrose than other varieties despite being the only variety not to respond to any ripener in either 1984 (Figure 1) or 1985. Compared with other varieties N13 produced low quality cane in all years, resulting in low sugar yields.

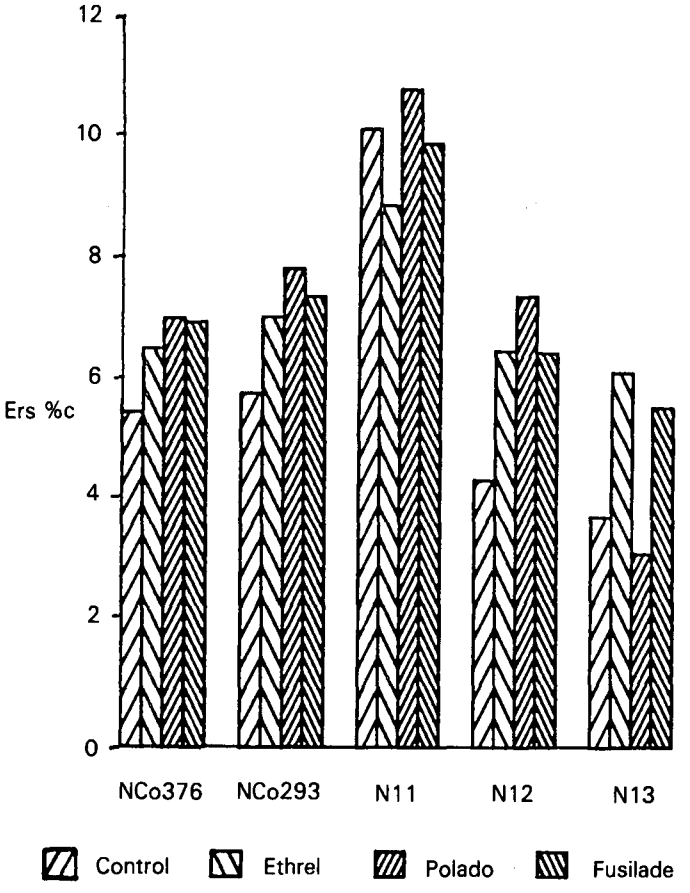

FIGURE 1 The effect of ripeners on the percentage estimated recoverable sugar of varieties in 1984.

2. Ripeners

Visual symptoms All ripeners produced typical symptoms on all varieties but the degree of severity varied with variety. Ethrel symptoms were most marked on N11 and NCo376 and least marked on N12. Ethrel restricted stalk growth temporarily, producing one shortened internode and axillary bud swelling in this region of the stalk. Polado checked growth more severely than Ethrel and induced more prolific axillary bud growth (side-shooting) at the top of the stalk. Both chemicals reduced the size of upper leaves. Fusilade Super produced marked effects, particularly on varieties N11, N13 and NCo293, killing one or two of the youngest spindle leaves and producing a black ring of cauterised or "ring-barked" tissue on one or two young internodes. At the higher rate of application in 1986 "ring-barking" was more marked and the growing point was killed on some stalks of all varieties. Side-shoots began to develop at the top of treated stalks but they were not as vigorous as those on Polado-treated stalks. The death of young leaves reduced the canopy of varieties N11 and N13 to a greater extent than in other varieties.

Cane yield and quality All ripener treatments improved cane sucrose percentage and juice purity in all years, resulting in improvements in percentage estimated recoverable sugar (ers % cane). Sample data indicated that the ripening benefits of all ripeners were detectable between 4 and 6 weeks after treatment. Figure 2 illustrates the typical response to ripeners with time, using 1986 data. Varieties NCo376 and N13 appeared to respond quickest and N12 tended to respond slower than other varieties. Quality improvements were then maintained until harvest, which was 12 weeks after harvest in 1984, 9 weeks in 1985 and 10 weeks in 1986.

With the exception of Polado and Fusilade Super in 1985, improvements in quality were statistically significant at harvest and resulted in statistically significant increases in ters/ha for all ripeners in all years (Table 1).

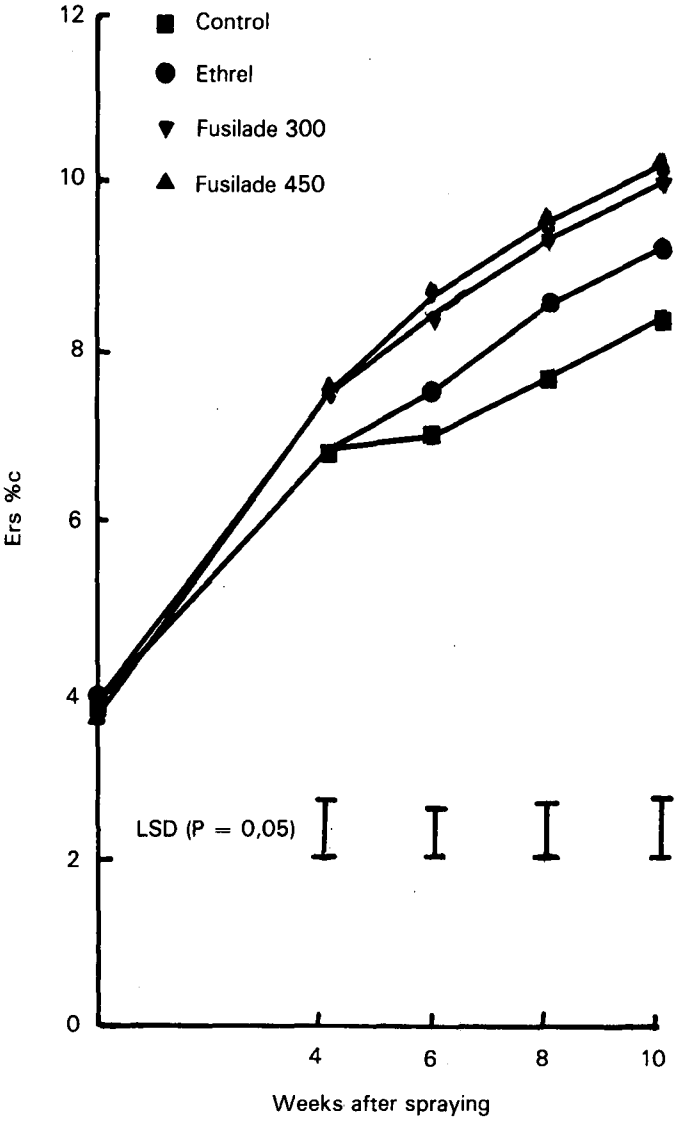

FIGURE 2 Changes with time in percentage estimated recoverable sugar in 1986. Means of all varieties.

Increasing the rate of Fusilade Super to 56 g ai/ha in 1986 further improved the ers % cane, of varieties NCo376, NCo293 and N11 (Figure 3); but these improvements were offset by reductions in cane mass and the best sugar yield for all varieties was obtained from a rate of 37,5 g ai/ha (Table 1).

3. Variety x Ripener interactions

There were no statistically significant variety x ripener interactions for any parameter in any year, possibly because of the limited replication available for this assessment. However, there was a consistent lack of response of N11 to any ripener in terms of both sample and harvest data in either 1984 (Figure 1) or 1985, when the quality of this variety in control plots was significantly better than that of other varieties. When variety N11 responded to Ethrel in 1986 there was a small benefit only, which appeared to be lost before harvest (Figure 3). Other apparent differences in varietal response to the ripening treatments were small and were considered to be due to chance.

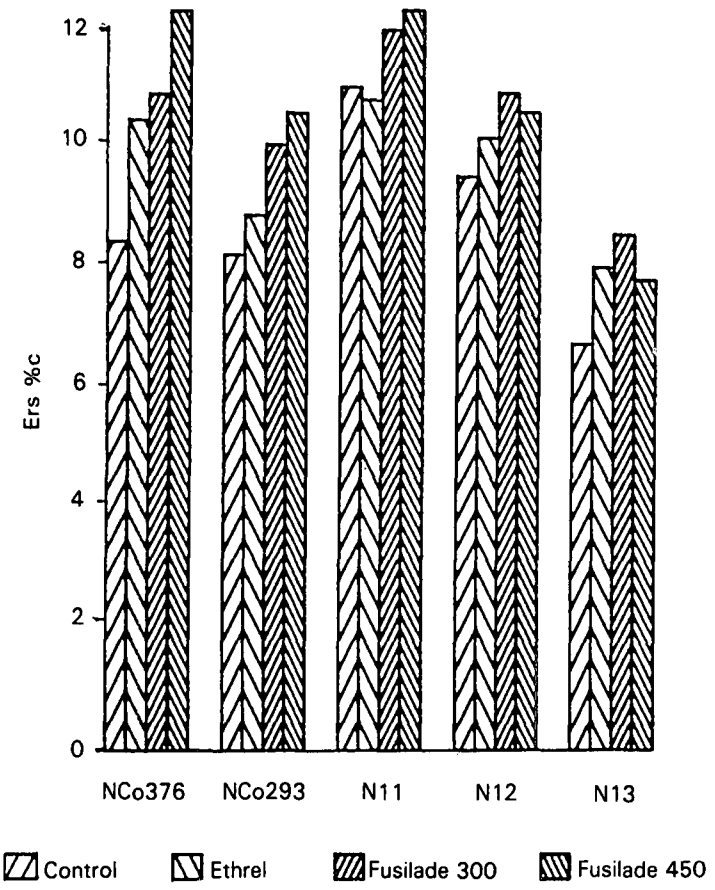

FIGURE 3 The effect of ripeners on the percentage estimated recoverable sugar of varieties in 1986.

Discussion

Good ripening responses have been obtained with other varieties growing under good growing conditions (Rostron[2], Leibbrandt[1], Turner[4]), one exception being variety N14 which responds inconsistently to Ethrel (Leibbrandt[1]). The results reported here confirm good ripening effects on all varieties except N11, which appears to be similar to N14 in its variable reaction. Detailed examination of weather conditions for the three years of the experiment did not indicate any apparent reason for N11 to respond to Fusilade Super in 1986 and not in the other two years. Nor did the condition of the crop at the time of spraying, because stalk moisture content and juice purity were suitable for good ripening effects to be obtained in all years. It is evident therefore that varieties may vary in their response to chemical ripeners, and that new varieties need to be screened carefully for their ability to respond to ripeners.

On this site the variety best suited for irrigated sugarcane production was N11, because it produced high yields in 1984 and 1986 and was the highest yielding variety in 1985, a low yielding year. It was also economically advantageous because chemical ripening was not needed to produce reasonable sugar yields.

It is interesting to compare the stalk dry matter percentage (dm %c – Table 2) and the sugar yield (ters/ha – Table 1) of the varieties in the three years. In both 1984 and 1985 dm %c and ters/ha for N11 were higher than that for other varieties, whilst in 1986 there was little difference in dm %c amongst the varieties and sugar yields were also similar. This suggests that N11 was able to use growing conditions more efficiently than other varieties in years when dry matter production by the sugarcane crop appeared to be limited by some (unknown) factor or factors.

Table 2

Dry matter % cane at the time of harvest

Variety	1984	1985	1986
NCo376	21,2	22,9	25,3
NCo293	22,2	22,7	24,5
N11	23,5	24,4**	25,4
N12	21,4	23,1	25,1
N13	22,1	21,9	23,5
Mean	22,1	23,0	24,8

** Statistically significant at the 1% probability level

The results of this work confirmed that Ethrel, Polado and Fusilade Super increase sugar yields of immature sugarcane by similar amounts when conditions are suitable for chemical ripening (Rostron *et al*[3]). The statistically non-significant reduction in cane yield in 1986 when increasing the rate of Fusilade Super resulted in an apparent loss of part of the ripening response, may be because harvest was delayed too long. A delay in harvest from 10 to 12 weeks was reported by Rostron[2] to lead to a loss in sugar benefit from treatment with either Polado or Fusilade. This occurred when the chemicals either caused excessive side-shooting, or restricted stalk growth severely, and untreated plants continued to grow and accumulate sucrose at a faster rate than treated plants.

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