THE EFFECT OF EARLY AND LATE SEASON HARVESTING ON THE RANKING OF 150 SUGARCANE CLONES FROM ONE CROSS

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Abstract

One hundred and fifty unselected clones from a biparental cross were grown in a replicated field trial at Pongola, South Africa. Sucrose yield was measured over four crops. The first two crops (plant and first ratoon) were harvested in June while the third and fourth crops (second and third ratoon) were harvested in October. Two commercial cultivars, NCo376 and N14, were included in the trial for yield comparisons. The sucrose yield rankings of the higher yielding clones from the unselected population across season (early and late) were compared. The output of commercial cultivars during the 1990s from the Pongola selection programme was studied in terms of their suitability to early and late harvests. Possible implications for the selection strategy, for the northern irrigated production areas of the South African sugar industry are discussed.

Keywords: sugarcane, sucrose, selection

Introduction

The selection programme for the irrigated northern production areas of the South African sugar industry, which is on the experiment station based at Pongola (latitude 27,40 S), has five stages. The first three are sucrose sampled and harvested in the early part of the season (April-July). Stage four is sucrose sampled, harvested and selected later in the season (September-November). Stage five has trials harvested both early and late and also includes other sites. The programme is therefore not running specifically to produce cultivars for the different harvest periods.

The northern irrigated areas are on a 12-month harvesting cycle. This cycle could possibly be exploited better to maximize sucrose production by breeding and selecting cultivars more specifically suited for harvesting at different times of the milling season. Sugarcane breeding and selection programmes in some countries produce cultivars specifically suited to different parts of the milling season, with emphasis on increased sucrose content early in the season (Berding and Bull, 1997; Cox et al., 1994; Mamet et al., 1996;). Some of the commercial cultivars produced by the Pongola programme are more suitable for the early season while others are better for the late season. There are also cultivars that can be harvested throughout the season. This has been confirmed in commercial cultivar yield trials harvested in both the early season and the late season (Redshaw et al. 1999). In this paper the implications of the results from the Pongola selection programme, and those obtained of the higher yielding clones from an unselected population of 150 clones harvested both early and late season, are discussed.

Methods

One hundred and fifty unselected clones obtained from a biparental cross were grown in a field trial in a randomized complete block with two replicates. The plots consisted of six lines seven and half meters in length. The trial was planted in April 1995. The early season sucrose yields were determined from the mean of two crops harvested in June 1996 and June 1997. After the second June harvest the cane was cut back in October 1997 to convert the trial to late season harvesting. The late season yields were determined from the mean of the two crops harvested in October 1998 and 1999. Two commercial standards with four plots each of NCo376, and N14, were included. Analysis of variance was first carried out on the data combined over all four crops, as the primary interest was the early/late Season X Clone interaction component, which would indicate the stability of clones across seasons.

The sucrose yields from commercial cultivars released for the northern irrigated areas during the 1990s were obtained from plant breeding trial records. The yield results for early season were from two variety trials harvested in May-June each year and there were seven crops in total. The late season data was from three variety trials harvested during the period from September–November every year. There were eleven crops. For this study both the released cultivars and the clones from the unselected population, with a sucrose content of two units

Table 1. Analyses of variance for tons cane per hectare (tcane), sucrose percent (suc%) and tonnes sucrose per hectare (tsuc).

Source	df	Mean squares		
		tcane	suc%	tsuc
Early/late Season	1	394334.8**	2521.1**	350.1**
Crop(Early/late Season)	2	5686.8**	12.3**	24.9**
Clone	155	1402.3**	7.1**	26.4**
Early/late Season x Clone	155	334.8**	2.1**	6.3**
Crop(Early/late Season) x Clone	310	192.9	1.1	3.7
Residual	624	166.8	1.1	3.7

** Significant at the 1% level of probability

above NCo376 at the early season were classified as being suitable for early season harvesting.

Results and Discussion

The mean square values were highly significant for most factors and interactions for all three components of yield (Table 1). A highly significant early/late Season X Clone interaction is illustrated further by results presented in Table 2, where only three clones were common to the top 15 clones selected for either early or late season harvesting.

The Crop-within-Season X Clone interaction was not significant for tons cane, sucrose percent and tons sucrose per hectare in the early and late season combined analyses. This indicates that the interaction is due to season (early/late) and not differences between crops per se.

Table 2 shows the top ranking ten percent (15 clones, as they represent the possible potential selections) on sucrose yield with the standards, NCo376 and N14. There were two standards of each commercial cultivar. The standard rankings are high as would be expected compared to the population of 150 unselected clones. Their relative ranking was lower in the early season as seven clones had higher yields of sucrose than the lowest ranked standard compared with three in the late season.

Both NCo376 and N14 are known to yield better when harvested late in the season relative to other commercial cultivars. This is supported in the present findings by their relative rankings to the unselected population being higher in the late season.

The effect on the rankings of early and late season harvesting on the top ten percent higher yielding clones from the unselected population, was that only three (20%) were common to both harvest times. It appears that some clones have a higher sucrose yield in different harvest periods within the harvest season.

However the higher sucrose yielding clones in the early season are not all suitable for early season harvest in terms of economic benefit. This is due to their yield components consisting of low sucrose content and high cane yield. The clones best suited to early season harvesting for economic reasons, were classified as having two units of sucrose more than Nco376 in the early season. Nine out of the top yielding fifteen in the early season were not two sucrose units above NCo376 (Table 3). The mean sucrose percent of NCo376 was 10.01 percent.

The mean sucrose yield groupings of the top 15 ranked clones selected for the early and the late season can be seen in Table 4. The gain in yield of the early season selections over the late selections when harvested in the early season was 2.6 tons sucrose per hectare. The yield difference between the two groups in the late season was 0.7 tons sucrose in favour of the late selections. Indicating that selecting for specific harvest periods could make gains in sucrose yield.

The Pongola programme is biased towards selecting early season clones in the first three selection stages, as this is when they are harvested and selected. Historically, however, the output of cultivars from the Pongola programme has both early and late season types. The high sucrose cultivars (two units higher than NCo376 in the early season) tend to be used for early season harvesting, because of better milling qualities and lower transport costs. However during the 1990s approximately equal numbers of early and late season cultivars were released according to their sucrose classification (Table 5).

Table 2. Ranking on sucrose yield of the top ten percent of 150 unselected clones and two standard varieties (two plots each). Asterisks denote clones common to early and late season.

Rank	Early season selections over two crops	Late season selections over two crops	Combined yields of both early and late season of four crops
1	11	N14	N14
2	93*	NCo376	N14
3	78*	49	93*
4	N14	71	NCo376
5	116	NCo376	78*
6	35	111*	11
7	N14	N14	NCo376
8	5	142	111*
9	NCo376	100	71
10	111*	40	116
11	NCo376	19	49
12	62	93*	50
13	104	78*	5
14	50	73	30
15	123	30	100
16	39	72	62
17	119	144	134
18	143	38	119
19	1	47	85

Table 3. Sucrose percent content of the top 15 in sucrose yield at the early season. Asterisks denote clones suited to the early season harvest.

Early season clones	Sucrose percent cane
11	11.7
93	12.3*
78	12.3*
116	12.5*
35	11.8
5	12.1*
111	13.5*
62	12.2*
104	11.9
50	11.7
123	11.0
39	11.4
119	11.2
143	11.5
1	10.4

Table 4. Mean tons sucrose of the top 15 of 150 clones selected for early and late season harvesting.

	Mean of top 15 clones selected for early season	Mean of top 15 clones selected for late season	Difference between early and late top 15 means
Early season	16.2	14.5	1.7
Late season	13.6	15.2	1.6
Difference	2.6	0.7	

The Pongola selection programme could be portioned off for specific parts of the season to further maximize potential yield. One disadvantage however is that the present resources dedicated to the whole programme would be diluted. Also the programme has been producing both early and late season cultivars.

Conclusion

These results suggest that selection for harvesting in a specific part of the season in annually harvested crops would be beneficial. Not forgetting that the unselected clones in this study were only from one cross. Another motivation to breed and select for specific harvest periods, is the introduction in the 2000 milling season of more quality incentives for cane to be delivered to the mills in the South African sugar industry. This will further promote the judicious use of cultivars suited to specific harvest periods particularly early season ones to obtain better milling qualities.

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Table 5. Cultivars released during the 1990s from the Pongola research station, together with early/late classification and sucrose yield relative to NCo376

Cultivar and year of release	Season classification	Sucrose units above NCo376		Sucrose yield as percent of NCo376	
		Early	Late	Early	Late
N22 – 1991	Early	2.1	1.2	109.6	98.2
N23 – 1992	Late	0.4	0.5	112.0	101.7
N24 – 1993	Early	3.2	2.4	110.9	104.1
N25 – 1994	Late	0.3	0.3	105.9	109.0
N26 – 1995	Early	3.6	1.9	115.6	96.0
N28 – 1997	Late	1.8	1.0	102.2	107.9
N30 – 1997	Early	3.3	2.6	114.5	109.1
N32 – 1998	Late	1.6	1.0	108.1	113.2