

# FURTHER RESULTS FROM EXPERIMENTS WITH FIVE VARIETIES HARVESTED AT DIFFERENT AGES

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### Abstract

An experiment, laid down to determine the effects of age at harvest and time of harvest on five sugarcane varieties grown under rainfed conditions in the coast lowlands of Natal, is described. Results indicate that maximum production of sucrose can be obtained by harvesting a plant crop at twenty months of age, the first ratoon at twelve months and subsequent ratoons at progressively older ages. Adhering to a strict 12 month cropping cycle can give maximum returns only if the crop is harvested in spring or early summer. Should this be impossible, a longer cropping cycle is advocated since yields of sucrose of old sugarcane are least affected by time of harvest. Varietal differences are discussed.

### Introduction

The question of harvesting frequency has been debated for many years because it is so closely bound to the economics of cane farming. Pearson<sup>1</sup> conducted experiments between August 1960 and August 1964, and found that maximum returns were obtained when cane was cut every twelve months. Other evidence, however, (Moberly<sup>2</sup>) showed that 12-month cycles were not always the optimum. The experiment described in this paper was designed to gain further information on the effects of frequency of harvest on the yields of five sugarcane varieties.

### Experimental method and design

The experiment was established in September 1965 at the S.A.S.A.'s Experiment Station farm at Shaka's Kraal on a Williamson series (Dwyka) soil. The experiment was conducted under rainfed conditions.

The experiment comprised split plots in a randomized block design with four replicates. Whole plots were used for the "age at harvest" treatments and sub-plots were made up of the different varieties. The four ages at harvest were twelve (T1), sixteen (T2), twenty (T3) and twenty-four (T4) months. The five varieties were NCo 376, NCo 382, N53/216, N51/168 and N50/211.

Gross plots consisted of five rows 1,4 m apart and 9 m long. Net plots comprised three rows 7,3 m long.

All treatments (with one exception) received equal amounts of fertilizer. The plant crop received 74 kg/ha P and 118 kg/ha K in the furrow and a top-dressing of 106 kg/ha N. With the exception of the T2 treatment in the second ratoon crop, all treatments received a top-dressing of 127 kg/ha N, 31 kg/ha P and 190 kg/ha K. The T2 second ratoon crop received only 125 kg/ha N and 118 kg/ha K because soil analyses showed an adequate P concentration in the soil.

Urea, muriate of potash and single super phosphate were used in all instances.

Cylindrical gypsum soil moisture resistance blocks were placed midway between the centre of the row and the centre of the interrow at depths of 15, 45, 75 and 105 cm in two replicates of each treatment. Block readings were taken twice weekly with a Bouyoucos meter. Stalk heights were recorded weekly in summer and monthly in winter, whilst stalk counts of the centre row of each plot were recorded monthly. The dates at which the treatments were harvested are shown in Table I.

It should be noted that the 2nd ratoon of the T1 treatment was harvested in error at 24 and not at the scheduled 12 months of age. The harvest data from this crop were therefore interchanged with the 2nd ratoon of the T4 treatment which was harvested at 12 months of age.

TABLE I

Dates of harvesting

Treat-ments	Crop			
	Plant	1st ratoon	2nd ratoon	3rd ratoon
T1 12 M	Oct., 1966	Sept. 1967	Sept., 1969	Sept., 1970
T2 16 M	Feb., 1967	June, 1968	Sept., 1969	
T3 20 M	May, 1967	Jan., 1969	Sept., 1970	
T4 24 M	Sept., 1967	Sept., 1969	Sept., 1970	

### Results and Discussion

#### (i) General yield data

Table II reveals that twenty month old plant cane yielded the maximum quantity of cane per unit of time. The mean yields in tc/ha/annum for the T1, T2, T3 and T4 treatments were 44, 54, 78 and 67 tc/ha/annum respectively. However, the sucrose contents of the 16 and 20 month old plant crops harvested during May and February were low, so that the highest yield of sucrose per unit of time was obtained by harvesting at 24 months of age. Sucrose percent cane was obviously not affected as much by the age of the crop as it was by the time of harvesting. Because ratoon crops develop more quickly than plant cane, the crops harvested regularly at 12 months of age enjoyed a clear advantage. The higher yield in tons cane/ha of the 12 month crops however, tended to be offset by the higher sucrose contents of the older crops.

After the first ratoon, the crop growth rate tended to decrease. This was evident from the yields of the second and third ratoon crops. Although the twelve month old cane of the second ratoon still outyielded the older cane in

TABLE II

Yields of all crops of five varieties harvested at four ages and different seasons

Varieties		Plant crop				1st ratoon				2nd ratoon				3rd ratoon	Variety Means
		T1 12M	T2 16M	T3 20M	T4 24M	T1 12M	T2 16M	T3 20M	T4 24M	T1 12M	T2 16M	T3 20M	T4 24M	T1 12M	
t.c./ha/ annum	NCo376	43	53	86	77	114	78	48	70	93	71	79	69	79	74
	N53/216	40	53	78	64	102	70	44	52	68	68	69	57	64	64
	NCo382	48	52	76	60	106	60	44	55	62	55	64	58	63	62
	N50/211	42	51	73	62	113	58	35	37	60	47	59	47	57	59
	N51/168	47	59	79	71	108	61	41	57	63	59	59	54	60	63
	Mean	44	54	78	67	109	67	42	54	69	60	66	57	65	64
Mean S % C	NCo376	14,1	11,5	10,2	14,7	13,6	15,4	14,4	15,8	14,1	15,4	14,6	16,3	14,3	14,2
	N53/216	14,7	12,0	10,9	15,5	14,5	15,9	15,4	16,5	14,0	15,8	14,8	17,0	14,8	14,7
	NCo382	14,1	10,5	9,3	15,2	12,7	14,6	13,4	15,5	12,9	14,1	14,4	15,2	13,4	13,5
	N50/211	14,1	9,6	9,2	13,6	12,0	14,5	14,0	16,0	13,7	14,4	14,5	15,5	13,5	13,4
	N51/168	13,7	12,0	10,2	14,4	11,2	15,0	14,1	15,4	13,3	14,1	14,6	15,8	13,7	13,6
	Mean	14,1	11,1	10,0	14,7	12,8	15,1	14,3	15,9	13,6	14,8	14,6	16,0	13,9	13,9
t.s./ha/ annum	NCo376	6,2	6,2	8,9	11,3	15,3	12,1	7,0	11,1	13,2	11,1	11,6	11,1	11,6	10,6
	N53/216	5,9	6,4	8,6	10,0	14,8	11,1	6,7	9,7	9,7	10,5	10,2	9,7	9,7	9,9
	NCo382	6,7	5,6	7,3	9,2	13,4	8,6	5,9	8,6	8,1	7,8	9,2	8,6	8,6	8,3
	N50/211	5,9	4,8	6,7	8,6	13,4	8,3	4,8	7,3	8,3	6,7	8,6	7,3	7,8	7,7
	N51/168	6,4	7,0	8,1	10,2	12,1	10,0	5,6	8,3	8,3	8,6	8,6	8,3	8,3	8,3
	Mean	6,2	5,9	7,8	10,0	13,7	10,0	5,9	8,9	9,4	8,9	9,7	8,9	9,2	8,8
Rainfall (mm)		772	1333	1720	1798	1026	1181	1278	1800	1113	1082	1717	1800	1107	

terms of tons cane per unit of time, this is not always so in terms of sucrose yield.

When examining the total yields over the full crop cycles for all treatments (Table III), it is seen that, in terms of tons cane, the greatest yield was obtained from 12-monthly harvests. However, because of the higher quality of the older cane the total sucrose production was virtually the same for the crops harvested at 12 and 24 monthly intervals. Harvesting at 16 and 20 months of age necessarily entails harvesting at unfavourable times in some years.

A study of Table IV shows that the crops which yielded most cane per unit of time, also tended to be those that showed the highest water use efficiency.

#### (ii) Varietal effects

A feature of the yields of the five varieties was that NCo 376 and N53/216 overshadowed the other three varieties. These two varieties yielded more tons sucrose per hectare per unit of time in all ratoon crops (see Table II). This superiority of NCo 376 and N53/216 was not evident in the plant crop since both varieties were relatively slow growers initially.

(a) NCo 376: The development of NCo 376 in the plant crop was slow in comparison with the varieties N51/168 and NCo 382. With harvesting at an age greater than twelve months, the relative position of NCo 376 improved. At twenty and twenty-four months of age,

TABLE III

Total yields for the full crop cycle

Varieties	t.c./ha/annum				S % C				t.s./ha/annum			
	12 M	16 M	20 M	24 M	12 M	16 M	20 M	24 M	12 M	16 M	20 M	24 M
NCo376	83	67	59	72	14,0	14,2	13,0	15,6	11,5	9,1	7,6	11,2
N53/216	68	63	53	57	14,5	14,6	13,7	16,3	9,9	9,2	7,2	9,3
NCo382	69	55	51	58	13,3	13,1	12,3	15,3	9,2	7,3	6,2	8,8
N50/211	66	52	45	48	13,3	12,8	12,5	15,0	8,8	6,6	5,6	7,2
N51/168	69	62	49	60	13,0	13,7	13,0	15,2	8,8	8,4	6,3	9,1
Mean	71	60	52	59	13,5	13,7	12,9	15,5	9,6	8,2	6,5	9,2

**TABLE IV**  
**Water use efficiencies of five varieties**  
 (t.c./ha/100 mm of rainfall)

Varieties	Treatment													Variety Means
	12 months				16 months			20 months			24 months			
	Crop				Crop			Crop			Crop			
	P	R1	R2	R3	P	R1	R2	P	R1	R2	P	R1	R2	
NCo376	5,6	8,5	8,3	7,2	5,3	8,8	8,7	8,1	6,3	7,6	8,5	7,8	7,6	7,5
N53/216	5,2	7,6	6,1	5,8	5,4	7,9	8,3	7,4	5,7	6,6	7,2	5,7	6,3	6,6
NCo382	6,2	8,0	5,5	5,7	5,3	6,7	6,7	7,2	5,7	6,3	6,7	6,1	6,4	6,3
N50/211	5,4	8,4	5,4	5,2	5,1	6,5	5,8	7,0	4,6	5,7	7,0	4,2	5,2	5,8
N51/168	6,1	8,1	5,6	5,4	5,9	7,5	7,3	7,5	5,3	5,7	7,8	6,3	5,9	6,0
Mean	5,6	8,2	6,2	5,8	5,4	7,5	7,3	7,4	5,5	6,3	7,4	6,0	6,3	6,1
Overall Mean	6,5				6,7			6,4			6,6			

NCo 376 was superior to the other varieties. The sucrose content of this variety was surpassed only by that of N53/216, but because of the high tonnage of cane produced by NCo 376, this variety maintained the top position in terms of t.s./ha.

In the ratoon crops NCo 376 tended to perform best when cut at a young age.

- (b) N53/216: The performance of this variety showed the same trends as did NCo 376. As already stated N53/216 had a lower yield in t.c./ha but a higher sucrose content than did NCo 376.
- (c) NCo 382: This variety performed better in the 12 month plant crop than did any other variety, yielding slightly more t.s./ha than any of the other four varieties. After twelve months however, its relative position dropped sharply. In the second ratoon crop its yield per unit of time, like those of the other varieties, remained relatively constant up to the age of twenty-four months, although its position relative to the other varieties seemed to improve with age.
- (d) N51/168: The relative yields in ts/ha of N51/168 tended to remain constant with increasing

age. The yields in t.c./ha of N51/168 compared favourably with those of NCo 376 in the plant crop, but decreased markedly in subsequent ratoons.

- (e) N50/211: Relative to the other varieties, N50/211 remained the poorest variety at all ages of harvest and in all ratoons. Yields of this variety in t.c./ha were so low that not even a reasonably good sucrose content could increase its relative position in terms of t.s./ha.

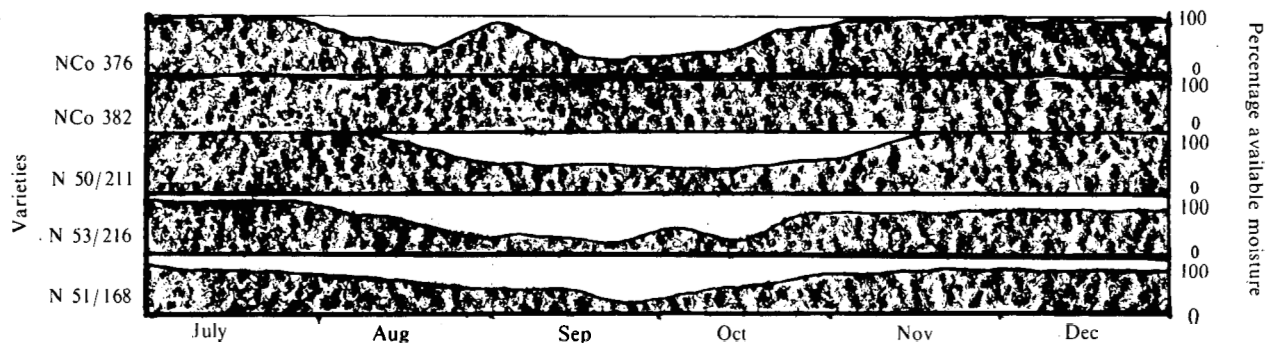
(iii) *Soil moisture extraction patterns*

Figure 1 illustrates that varieties N53/216 and N51/168 started extracting moisture at the 105 cm depth earlier than did the other varieties, whilst variety NCo 382 extracted little or no water at this depth.

(iv) *Stalk populations*

The data presented in Table V show the expected increase in stalk populations from the plant to the ratoon crops. Populations in successive ratoons were remarkably constant with the exception of the 20 month old first ratoon harvested in May, for which populations remained relatively low. Characteristically, NCo 376 had a relatively high stalk population.

Figure 1. Soil moisture % at the 105 cm depth for five varieties



**TABLE V**  
**Stalk counts at harvest (thousands per hectare)**

Varieties	12 M Crop				16 M crop			20 M crop			24 M crop			Variety
	P	R1	R2	R3	P	R1	R2	P	R1	R2	P	R1	R2	Mean
NCo376	133	139	141	131	133	139	126	146	110	144	136	133	140	135
N53/216	94	123	122	117	101	115	121	111	90	109	109	117	122	112
NCo382	116	124	119	124	128	118	105	131	99	114	114	131	119	119
N50/211	89	109	116	122	99	112	84	104	76	108	106	74	116	103
N51/168	84	89	104	102	86	98	86	96	75	99	109	111	104	96
Mean	104	119	120	119	109	116	104	119	90	115	115	117	120	113

### conclusions

The data show that 12 month old crops do not always yield maximum crops. Under the conditions of this experiment, maximum yields would have been obtained if the crops had been harvested as follows: Plant crop at 24 months of age, first ratoon at 12 months of age, and second ratoon at 20 months of age. This harvesting cycle should result in higher profits in spite of the fact that the 12 month harvesting cycle produced the highest yields over a number of crops (Table III).

Within wide limits the age at harvest is shown to be relatively unimportant when compared with the effect of season. It is not unreasonable to recommend 12 month cutting

cycles for ratoon crops where rainfall is good and crops can be harvested at the optimum time, viz. from September to November. However, for ratoon crops harvested outside this period, the optimum cycle time is likely to be more than 12 months.

Generally, the five varieties tested performed rather similarly in the various cycles tested.

### REFERENCES

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2. **Pearson, C.H.O.** (1965) Harvesting frequency and its effect on yield, sugar recovery and the fibre content of cane. Proc. Ann. Cong. S.A. Sugar Tech. Ass. 39:187-192.