SUGARCANE VARIETIES FOR THE NORTHERN IRRIGATED AREAS OF THE SOUTH AFRICAN SUGAR INDUSTRY

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ABSTRACT

The results are presented of three irrigated sugarcane variety experiments planted in the lowveld of the eastern Transvaal and northern Natal. Over a period of seven years, seven crops were harvested in each of the three experiments. On the Makatini loamy clay soils along the Pongola River the varieties NCo 334, NCo 310, NCo 376, NCo 293 and N 55/805 were the outstanding varieties in terms of total yields of sugar. On the Maputa sands the varieties NCo 376 and N 55/805 performed best. Because of the susceptibility of some varieties to smut disease (*Ustilago scitaminea*) and leaf scald (*Xanthomonas albilineans*), the only varieties which should be considered at present for these northern irrigated areas of high yield potential are NCo 376 and NCo 334.

Introduction

The expansion of sugarcane production in the northern areas of the South African sugar industry has warranted research into all aspects of sugarcane agriculture under irrigated conditions, not the least of these being variety selection. With the establishment of the Experiment Station farm at Pongola in 1966 it first became possible to lay down field experiments under the strictly controlled conditions which are necessary for research work to be done. Concurrently, two experiment farms were being established by the Department of Agricultural Technical Services on the Makatini flats. In these circumstances it followed logically that the relative performance of all of the suitable released sugarcane varieties should be tested on three sites as soon as possible.

Materials and methods

Sites

The experiment site at Pongola and one of the sites at the Makatini Research Station were situated on Makatini clay loam soils. The second site at Makatini was on a Maputa deep sand. The analytical data for soil samples taken before the experiments were planted and after harvesting the sixth ratoon crops, are given in Table 1.

Design and varieties

Twelve sugarcane varieties were planted in a 3 x 4 lattice design at Pongola. They were: NCo 376, NCo 293, NCo 310, NCo 382, NCo 334, N 50/211, N 51/168, N 51/539, N 53/216, N 55/805, CB 36/14 and CB 38/22. At Makatini six varieties were planted in latin squares at each of the two sites. On the Makatini clay loam the varieties NCo 376, NCo 310, N 55/805, N 53/216, N 51/168 and CB 36/14 were planted, and on the Maputa sand the varieties were NCo 376, N 55/805, NCo 382, N 51/168, N 51/539 and N 50/211.

Irrigation

Irrigation laterals were spaced 18 m apart in all three experiments, sprinkler risers being 18 m apart along the laterals. Soil moisture profit and loss accounts were kept for all experiments and in the early crops irrigation water was applied whenever the soil moisture deficit warranted an application. In the later crops water was applied on a minimum cycle time ranging from 14 to 25 days. Sixty millimetres of water was applied over a 12-hour period. During the plant stage of the crop on the Maputa sand it was also intended that each irrigation cycle should comprise 60 mm of water applied over a 12-hour period. Pressures were inadequate, however, and water distribution was therefore poor and the amounts applied were probably less than those intended. From the first ratoon stage onwards only 30 mm of water was applied per cycle, nozzle pressures were raised to the specific level, and distribution became satisfactory. In the early crops on the Maputa sand the rooting depth

TABLE I

Analyses of soil samples taken before planting and after harvesting the sixth ratoon crops

Site/Nutrients	Year	ppm P	ppm K	ppm Ca	ppm Mg	pH	O.M.%	T.A.M.*
Pongola (clay loam)	1966	4	295	700	330	6,1	2,61	200 mm
	1973	16	285	707	500	6,8	—	200 mm
Makatini (clay loam)	1966	7	360	380	174	5,6	1,73	100 mm
	1973	24	191	510	278	6,9	1,46	100 mm
Makatini (sand)	1966	7	130	120	100	5,0	0,94	35 mm
	1973	14	56	340	165	6,6	0,86	50 mm

* Total available moisture

was observed to be about 70 cm. Available moisture was measured to be 50 mm per metre of soil depth and therefore the total available moisture (T.A.M.) of the soil was calculated to be 35 mm. During the fourth ratoon crop it was found that the roots had penetrated deeper than 1 m and the estimated T.A.M. was increased to 50 mm. However, 30 mm of water was still applied whenever a deficit of 30 mm was reached.

On the clay loams at Pongola and Makatini, irrigation was discontinued six weeks before harvesting and on the Maputa sand irrigation was discontinued four weeks before harvesting in order to ripen the crops.

Fertilization

All three experiments were fertilized by applying the necessary P and K, the amounts depending on the measured soil content of available P and K. N was applied at rates ranging between 150 and 165 kg per hectare per crop except for the sixth ratoon crop at Pongola, which received 120 kg N per hectare. The soil analyses indicated the presence of adequate Ca and Mg. However, findings by Sumner[1] showed that aluminium was present in the Maputa sand in toxic quantities and consequently gypsum was applied to the experiment on this soil type at a rate of 400 kg/ha for the second, third and fourth ratoons, and 200 kg/ha for the fifth and sixth ratoons.

All three experiments were planted during December 1966 and harvested at approximately twelve-monthly intervals during either September, October or November.

Results

Yields of cane

The experiments on the clay loams gave mean annual yields of 117 tc/ha and 127 tc/ha at Pongola and Makatini respectively. The higher yields at Makatini were due not only to the fact that additional lower yielding varieties were included in the Pongola experiment, but probably also to the higher air temperatures experienced on the Makatini flats. The mean monthly temperatures for the two areas are given in Table II and the mean Class A Pan evaporation data are shown in Table III.

The mean annual yield on the Maputa sands was 100 tc/ha. This is lower than the mean yields on the clay loam soils mainly due to the poor plant crop when irrigation was unsatisfactory.

Cane quality

Cane quality on the Pongola and Makatini clay loams was very similar. This was to be expected since the soils, the irrigation procedures and the drying-off period were the same on the two sites. However, estimated recoverable sugar (ERS) % cane values on the sandy soil at Makatini were consistently higher than those on the clay loams. This was due possibly to the more effective drying-off on the sands. The mean ERS % cane data for 12 varieties are given in Table IV.

Sugar yields

Since the cane yields and cane quality were reasonably similar at Pongola and Makatini, the yields of ters/ha from the two experiments were very similar, viz.: 14,5 ters/ha and 15,0 ters/ha per annum respectively. The lower average yields of the experiment on the sands were due only to the lower cane yields of the plant and first ratoon crops which resulted in low ters/ha for these crops. This is illustrated in Figs. 1 and 2.

Yield trends

In addition to the differences in the mean annual yields of the three experiments, there are important differences in the trends of the yields over seven crops. These trends are shown in Figs. 1 and 2. The most significant trend is that the yields of tc/ha from the Pongola experiment have declined in the later ratoons.

TABLE II

The 5-year mean (1968-1972) daily temperatures at Pongola and Makatini (°C)

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
Makatini	27,1	26,1	25,0	23,0	20,0	16,5	17,1	19,2	21,5	22,8	23,7	28,0	22,5
Pongola	25,6	24,4	23,2	21,2	18,5	15,5	16,2	18,0	20,3	21,7	22,5	24,6	21,0
Difference..	1,5	1,7	1,8	1,8	1,5	1,0	0,9	1,2	1,2	1,1	1,2	1,4	1,5

TABLE III

The 4-year (1969-1972) mean evaporation from Class A Pans at Pongola and Makatini (mm)

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
Makatini	9,8	8,9	7,1	6,1	4,5	4,2	4,7	5,8	7,0	7,4	8,0	8,5	6,8
Pongola	7,2	6,2	5,4	4,2	3,4	3,0	3,4	4,4	5,6	5,7	5,9	6,8	5,1
Difference..	2,6	2,7	1,7	1,9	1,1	1,2	1,3	1,4	1,4	1,7	2,1	1,7	1,7

TABLE IV

Mean ERS % cane data for twelve varieties at Pongola and Makatini, 1967-1973

Variety	NCo 310	N 55/805	CB 36/14	NCo 334	NCo 293	NCo 376	N 53/216	N 50/211	NCo 382	N 51/168	N 51/539	CB 38/22
Pongola (clay loam) ..	13,5	12,5	13,2	12,4	12,4	11,4	11,3	11,1	10,1	10,6	10,9	12,5
Makatini (clay loam) ..	12,8	12,5	11,6	—	—	11,3	11,3	—	—	11,7	—	—
Makatini (sand)	—	14,7	—	—	—	13,3	—	13,0	11,9	12,9	12,9	—

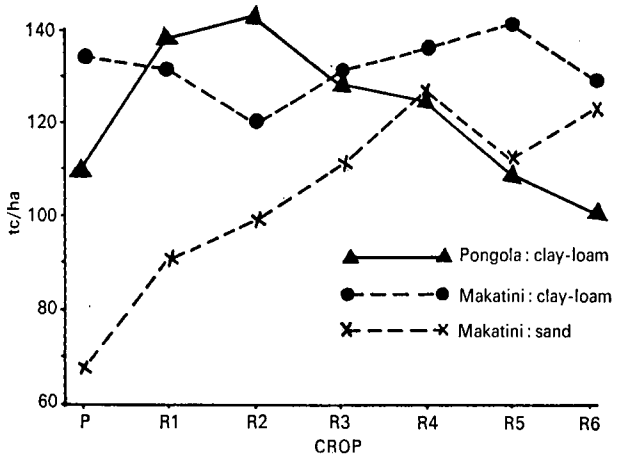

FIGURE 1 The annual trends of tc/ha in three irrigated sugarcane variety experiments.

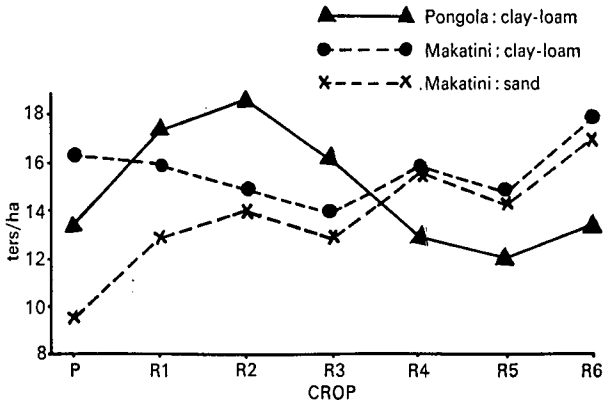

FIGURE 2 The trends of ters/ha in three irrigated sugarcane variety experiments.

This has been especially evident in the fifth and sixth ratoon crops. Since the change in stalk populations per hectare from the plant through the ratoon crops was very small, the declining yields can only be attributed to a decrease in the stalk weights.

In contrast to the Pongola experiment, the yields on the clay loam soil at Makatini have remained consistent and show no declining trend, whilst yields on the Makatini sand have shown a trend of rising yields. The increasing yields on the sandy soil have been associated with increasing stalk populations in successive crops. The average population was 109 000 stalks per hectare in the plant crop, and this increased progressively to an average of 127 000 in the sixth ratoon crop. The increases in populations and yields may have been due to improved water relations within the crop, resulting both from better irrigation control and deeper crop rooting as the possible aluminium toxicity factor was ameliorated.

Varietal differences

Yields—The yields of varieties in terms of both tc/ha and ters/ha are compared in Fig. 3. On the clay loam at Pongola, the varieties NCo 376, NCo 334, NCo 293 and NCo 382 gave the best yields of tc/ha over seven crops. In terms of ters/ha, however, NCo 382 did not compare with the varieties NCo 376, NCo 334 and NCo 293 because of its low ERS % cane. The varieties NCo 310, CB 36/14 and N 55/805 had relatively high ERS contents and their yields of ters/ha therefore compare favourably with those of NCo 376, NCo 334 and NCo 293. The same comments may be made regarding the varieties NCo 376, N 55/805 and NCo 310 on the Makatini clay loam. NCo 376 gave high yields of cane with a low ERS content, whilst NCo 310 and N 55/805 gave lower yields with higher ERS contents.

On the Maputa sands only two varieties did well. These were NCo 376 and N 55/805. Although their yields of cane were lower than those of the same varieties on the other soils, a higher ERS % cane resulted in very similar yields of ters/ha.

Lodging—All varieties tended to lodge in the two experiments on clay loam soils. The degree of lodging at Pongola tended to vary between varieties, the varieties CB 38/22, CB 36/14, N 50/211 and NCo 310 lodging more severely than the other varieties. Ratings for lodging in the fifth ratoon at Pongola are given in Table V. Lodging on the clay loam soil at Makatini was always so severe that no differences between varieties could be recognised. There was no lodging on the sandy soil at Makatini.

Diseases—Smut disease (*Ustilago scitaminea*) was found in all three experiments, but only on a very limited scale. The first outbreak occurred in the fifth ratoon crop and the number of infected stools increased slightly in the sixth ratoon. The number of smut whips

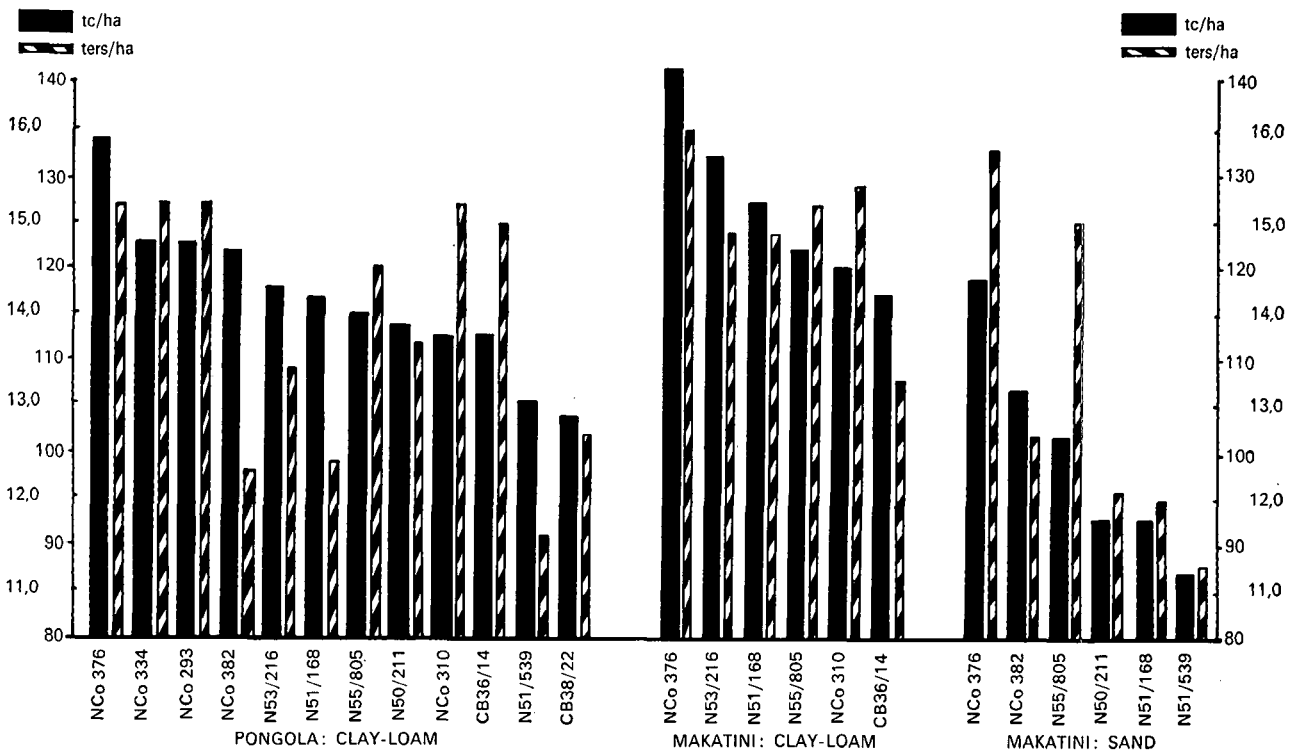

FIGURE 3 Mean cane and sugar yields from three irrigated sugarcane variety experiments.

TABLE V

Visual ratings of the degree of lodging in the fifth ratoon crop at Pongola

Variety	CB 38/22	CB 36/14	N 50/211	NCo 310	NCo 382	NCo 293	NCo 334	NCo 376	N 51/168	N 53/216	N 55/805	N 51/539
Rating	4,0	3,0	3,0	3,0	2,5	2,0	2,0	2,0	1,5	1,5	1,5	1,0

Lodging: 1 = none 2 = slight 4 = very severe

TABLE VI

The total number of smut whips per hectare in the sixth ratoon crops of three experiments

Variety	Pongola	Makatini (clay loam)	Makatini (sand)
NCo 310.. ..	5 400	770	—
N 55/805.. ..	2 700	3 000	3 050
NCo 293.. ..	400	—	—
N 53/216.. ..	200	—	—

counted in the sixth ratoons of the three experiments are given in Table VI.

Isolated cases of gumming disease (*Xanthomonas vasculorum*) were identified in NCo 310.

Flowering—All the varieties flowered except NCo 382, N 51/539 and CB 36/14. Flowering was exceptionally heavy during the sixth ratoon and the percentage of the total number of stalks of each variety which flowered is given in Table VII.

Discussion

If 14,5 ters/ha per annum is an acceptable experimental yield under irrigated conditions then there are eight varieties which could be considered for planting on the clay loam soils of the lowveld. These are NCo 376, NCo 334, NCo 310, NCo 293, N 55/805, CB 36/14, N 53/216 and N 51/168. Since the occurrence of diseases is of major importance in the northern areas, the selection of varieties resistant to smut disease and leaf scald is of utmost importance. Because of their susceptibility to smut disease, the varieties NCo 293, NCo 310, N 55/805 and N 53/216 cannot therefore be considered for general commercial production. CB 36/14 and N 51/168 are susceptible to leaf scald and the establishment of these varieties cannot be recommended, nor can N 55/805 be recommended for planting on the Maputa sands. The varieties NCo 376 and NCo 334 are thus the only two varieties which can safely be recommended for heavier soils in the northern irrigated areas, and on the sands NCo 376 is at this juncture the only disease-resistant variety which should be used.

A further significant observation is that high productivity can be maintained over a considerable

TABLE VII The percentage of flowering stalks in the sixth ratoon crops of twelve varieties at Pongola

Variety	NCo 293	N 50/211	NCo 310	NCo 376	N 51/168	N 55/805	NCo 334	N 53/216	CB 38/22	NCo 382	N 51/539	CB 36/14
Flowering % ..	30	28	26	15	13	9	8	2	1	0	0	0

number of crops and years. These experiments were harvested during the high sucrose period but other recently-initiated experiments will be used to compare varieties when they are harvested every 12 months during winter.

The high yields obtained on the Maputa sands are very encouraging and it would appear that maximum yields are obtainable on these soils providing that cultural practices and irrigation control are of a sufficiently high standard.

Conclusions

Although eight varieties gave good yields of ters/ha on the clay loam soils over a period of seven years, only two of these varieties, NCo 376 and NCo 334, are recommended for planting in the northern irrigated areas. The varieties NCo 310, NCo 293, N 55/805 and N 53/216 are all susceptible to smut disease and CB 36/14 and N 51/168 are susceptible to leaf scald and should therefore not be planted.

NCo 376 is the only variety suitable for planting on the sands.

The clay loams and the sands have an equally high yield potential of 14,5–16,0 ters/ha per annum when harvested during the high sucrose period between September and November.

Acknowledgements

Thanks are due to officers of the Department of Agricultural Technical Services, and especially Mr J. Duckworth, who have maintained the experiments at the Makatini Research Station.

REFERENCE

1. SUMNER, M. E. (1970). Aluminium toxicity — a growth-limiting factor in some Natal sands. SASTA Proc. 44 : 176-181.