THE EFFECT OF QUANTITY OF SEEDCANE, FILTERCAKE AND IRRIGATION ON SUGARCANE YIELD

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ABSTRACT

The results are reported of an experiment designed to determine the way in which different seed rates at planting influence the yield and growth pattern of varieties NCo 376 and N 55/805. They indicated that comparable yields can be obtained from planting with setts and double whole stick in the case of variety NCo 376 and with setts and treble whole stick in the case of variety N 55/805. The weight of seedcane required for double whole stick planting is similar to the amount required when planting with setts. Filtercake applied in the planting furrow accelerated the development of cane leaf canopy and increased sugarcane yields. Supplementary irrigation substantially increased yields of all treatments for both varieties.

Introduction

Throughout the South African sugarcane industry various methods of planting sugarcane are practised, but cutting cane stalks into "setts" and placing these overlapped in the planting furrow is probably the most commonly used method of planting. With the rising cost of labour, however, growers are becoming conscious of the high labour demand involved in preparing and planting setts, and hence a less labour intensive planting practice would be desirable. Planting whole sticks in the furrow reduces the labour requirements as a result of easier handling and fewer operations, but it is not known whether by using this method, similar germination to that obtained with setts can be achieved and if so, what quantity of seedcane is required.

Handweeding, cultivation, and the application of herbicides, are all useful weed control measures, but the shading effect caused by the cane leaf canopy can assist as a natural form of weed control. Consequently good germination, rapid tillering and the subsequent early development of a full leaf canopy may reduce the labour required for weed control.

An experiment was established therefore to compare the germination and ultimate yield resulting from different planting practices under rainfed and irrigated conditions.

Materials and methods

Location and design of experiment

The experiment, a variation of a replicated block design, was located on a Windermere clay on the Ottawa section of Huletts Sugar Limited, Natal Estates, on the Natal north coast. The mechanical analysis is shown in Table I.

TABLE I

Mechanical analysis of Windermere clay[1]

Depth in cm	Coarse sand %	Fine sand %	Silt %	Clay %
0– 30	14	7	27	45
30– 60	9	3	15	69
60– 90	6	6	26	62
90–120	20	15	28	34
120–150	27	19	23	29

The sugarcane was planted in September 1972 and was harvested at 12 months of age in September 1973. The criterion for harvesting was simply the time when the best treatment had reached a millable stage of growth.

Treatments

The treatments consisted of seven different planting practices under rainfed and irrigated conditions, using two sugarcane varieties.

(i) Varieties:
V_1 : NCo 376
V_2 : N 55/805

(ii) Irrigation:
B_1 : rainfed
B_2 : irrigated

Irrigation water was applied by an overhead sprinkler system which was controlled by means of a profit and loss account using an estimated total available moisture (TAM) figure of 65 mm. Twenty-five millimetres of irrigation water was applied at 17-day intervals provided the soil moisture deficit was at least 25 mm. Over the 12-month crop duration, 339 mm of supplementary irrigation were applied.

Drying-off procedure was practised with the final irrigation being applied four weeks prior to harvest.

(iii) Seed type and rates:
T_1 : setts
T_2 : setts + filtercake
T_3 : single whole stick
T_4 : single whole stick + filtercake
T_5 : double whole stick
T_6 : double whole stick + consolidation
T_7 : treble whole stick.

Notes on treatments

(i) The seedcane used for both varieties NCo 376 and N 55/805, was 11-months-old first ratoon cane from a nursery in which the seed had been hot-water

treated (HWT). Average length of stick was 1,0 metre with an average number of nine eyes (or buds) per stick.

(ii) Where setts were used the trash was removed from the cane stalk prior to its being cut into "four-eyed" lengths, and placed in the planting furrow with a 50% overlap.

(iii) The whole stick treatments had the untrashed stalks placed in the furrow "tip-to-butt" as a single, double or treble line depending on the treatment.

(iv) Prior to planting, setts were completely immersed in a 0,5% Benlate solution and the whole sticks had each cut end dipped into the same solution.

(v) For treatments T_2 and T_4 filtercake was applied in the furrow before planting at a rate of 50 tons per hectare. From the filtercake analysis the calculated nutrients provided were 374 kg total N, 185 kg available P and 42 kg available K per hectare. The filtercake contained 56% moisture.

(vi) The consolidation in treatment T_6 was done by a mule-drawn light roller taken along the planted row after covering the seedcane.

Fertilizer

The analytical results of soil samples taken prior to planting showed the area to have adequate P and therefore fertilizer was not applied at planting. At 3 months of age the crop was fertilized with a top-dressing of 141 kg N and 141 kg K per hectare.

Weed control

Immediately after planting, alachlor (1,92 kg a.i./ha) + atrazine (1,0 kg a.i./ha) was applied pre-emergence and this gave good control of grasses and broad-leaf weeds. Four weeks after planting a *Cyperus rotundus* problem developed and in midNovember, diuron (1,8 kg a.i./ha) + M.C.P.A. (2,8 kg a.e./ha) + surfactant was applied but gave poor control of the *Cyperus* spp. Early in December the trial was interrow cultivated by means of a mule-drawn cultivator, primarily for weed control measures but also to flatten the planting ridges. In March 1973 *Cyperus rotundus* had formed a dense sward in areas throughout the trial site and paraquat (0,6 kg a.i./ha) + 2,4-D amine (3,2 kg a.e./ha) was applied, which gave excellent weed control through to harvest. All plots were treated in the same way regardless of the treatment.

Results

Weight of seedcane required

The weight of seedcane used for the four planting rates is shown for both varieties in Table II. The data for setts includes the weight of off-cuts. It is seen that the weight of seed required for planting is slightly higher for N 55/805 compared with NCo 376.

TABLE II

The weight of seedcane material used for the four planting rates of varieties NCo 376 and N 55/805

Weight of seedcane used (tons/hectare)

Seedcane rate	NCo 376	N 55/805
Setts	6,7	7,3
Whole stick x 1	4,5	4,7
Whole stick x 2	7,8	7,9
Whole stick x 3	12,3	13,7

Growth of the crop

Shoot populations of NCo 376 and N 55/805 developed in a similar pattern in respect of treatments but the number of harvested stalks per hectare was in all instances highest with NCo 376. The pattern of shoot development of NCo 376 is graphically illustrated for both rainfed and irrigated conditions in Figs. 1 and 2.

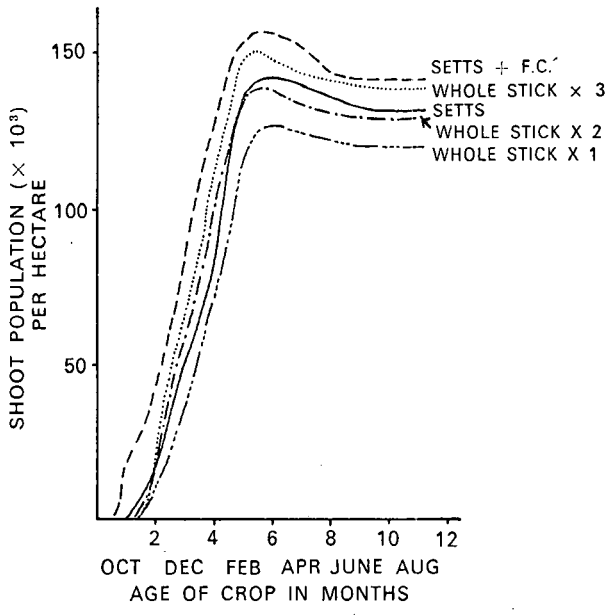

FIGURE 1 The pattern of shoot development in variety NCo 376 planted with different seed rates under rainfed conditions.

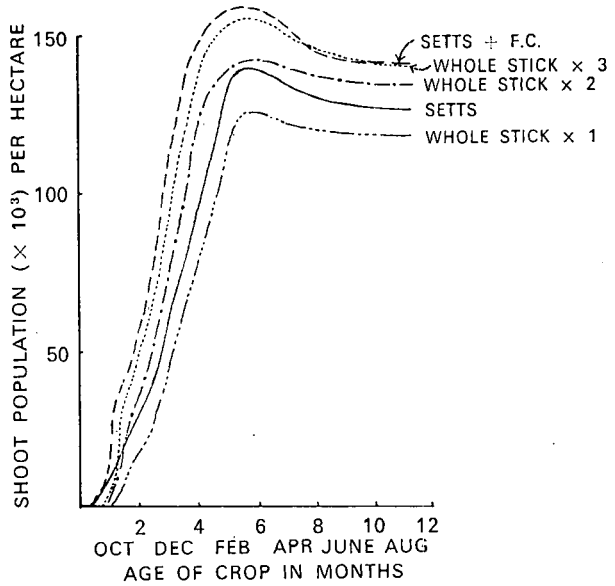

FIGURE 2 The pattern of shoot development in variety NCo 376, planted with different seed rates under irrigated conditions.

It can be seen that shoot development is very similar for both rainfed and irrigated conditions. Stalk populations appeared to peak at the same time for all treatments and the mortality rate was relatively low. Differences in shoot populations resulting from differ-

ent seed rates were maintained throughout the growth period of the crop, culminating in the treatment effects being reflected in the number of stalks harvested.

Filtercake increased the rate of tillering and the ultimate stalk populations but this effect is considerably more marked under rainfed conditions in the case of both NCo 376 and N 55/805.

The speed with which a crop reaches full leaf canopy is important for the control of weeds. At four and six months of age a visual assessment was made of the fullness of cane leaf canopy. These data are presented graphically in Figs. 3 and 4.

The effect of filtercake with setts in inducing rapid closing in of the leaf canopy is evident with both varieties but is particularly evident in the rainfed crops. There is no evidence of full canopy being achieved any quicker with the use of either setts, double or treble whole stick, but the single whole stick treatment resulted in a slow canopy formation.

Yield and crop characteristics

(i) *Response to seedcane rates*

The effects of the four planting rates on yield of variety NCo 376 are shown in Table III.

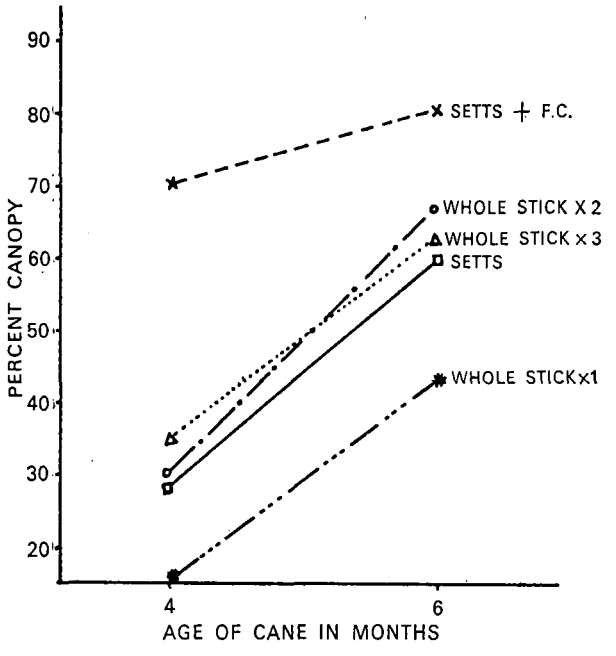

FIGURE 3 Visual assessment of cane leaf canopy using variety NCo 376 grown under rainfed conditions.

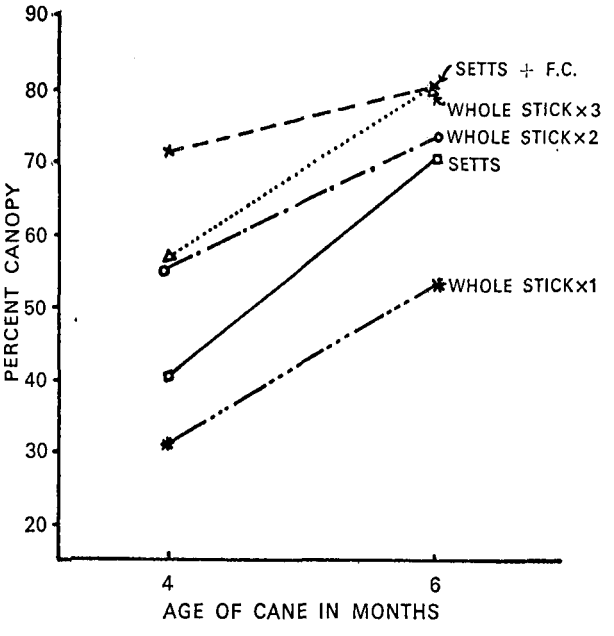

FIGURE 4 Visual assessment of cane leaf canopy using variety NCo 376 grown with supplementary irrigation.

TABLE III

The effect on yield of variety NCo 376 of planting with different seed rates under rainfed and irrigated conditions

Treatment	Rainfed			Irrigated		
	tc/ha	ers%C	ters/ha	tc/ha	ers%C	ters/ha
Setts	53	10,4	5,6	95	11,8	12,1
Whote stick x 1	50	10,8	5,3	70	12,0	9,4
Whole stick x 2	63	9,6	6,2	106	12,0	12,7
Whole stick x 3	55	11,0	6,3	109	12,1	13,3
Mean	55	10,4	5,8	95	12,0	11,9
Sub-plot CV%	13,2	13,6	15,6	7,3	2,8	6,2
LSD (0,05)	10,5	1,91	1,31	10,2	0,48	1,13
(0,01)	14,4	2,62	1,80	14,0	0,66	1,54

In terms of tons cane per hectare (tc/ha) there is an advantage in using double whole stick compared with setts. This advantage obtains a level of statistical significance under irrigated conditions. There is an indication that, under the dry conditions which prevailed during the growth of the crop, the treble whole stick rate was excessive, resulting in severe moisture stress and a decline in yield. This is supported to some extent by the fact that under rainfed conditions the stalk diameter in the treble whole stick treatment is thinner than that of cane in the other treatments. This effect can be seen in Table IV.

TABLE IV

Harvested crop characteristics of variety NCo 376 planted with different amounts of seed

Treatment	Rainfed			Irrigated		
	stalks/ha (x 10^3)	Mean stalk length cm	Mean stalk diam. mm	Stalks/ha (x 10^3)	Mean stalk length cm	Mean stalk diam. mm
Setts	116	90	22,8	152	128	22,8
Whole stick x 1	106	91	24,7	121	127	23,4
Whole stick x 2	120	102	22,6	165	135	23,3
Whole stick x 3	131	95	22,1	159	141	23,3
Mean	118	94	23,0	149	108	23,2
Sub-plot CV%	10,2	10,7		5,5	6,2	
LSD (0,05)	15,10	14		10,8	12	
(0,01)	20,68	19		14,7	16	

TABLE V

The effect on yield of variety N 55/805 of planting with different seed rates under rainfed and irrigated conditions

Treatment	Rainfed			Irrigated		
	tc/ha	ers%C	ters/ha	tc/ha	ers%C	ters/ha
Setts	63	10,8	6,7	113	13,5	15,3
Whole stick x 1	47	11,8	5,6	93	14,0	13,1
Whole stick x 2	57	10,3	5,9	101	14,4	14,0
Whole stick x 3	64	10,9	7,0	115	13,8	15,9
Mean	58	10,9	6,3	105	13,9	14,6
Sub-plot CV%	13,2	13,6	15,6	7,3	2,8	6,2
LSD (0,05)	10,5	1,91	1,31	10,2	0,48	1,13
(0,01)	14,4	2,62	1,80	14,0	0,66	1,54

TABLE VI

Harvested crop characteristics of variety N 55/805 planted with different amounts of seed

Treatment	Rainfed			Irrigated		
	Stalks/ha (x 10^3)	Mean stalk length cm	Mean stalk diam. mm	Stalks/ha (x 10^3)	Mean stalk length cm	Mean stalk diam. mm
Setts	101	92	25,8	137	146	27,3
Whole stick x 1	88	93	25,2	123	126	25,6
Whole stick x 2	95	104	25,0	134	138	24,6
Whole stick x 3	114	106	25,0	153	150	22,8
Mean	99	99	25,2	137	140	25,1
Sub-plot CV%	10,2	10,7		5,5	6,2	
LSD (0,05)	15,10	14		10,8	12	
(0,01)	20,68	19		14,7	16	

TABLE VII

The effect of filtercake on yield of variety NCo 376 grown under rainfed and irrigated conditions

Treatment	Rainfed			Irrigated		
	tc/ha	ers%C	ters/ha	tc/ha	ers%C	ters/ha
Setts	53	10,4	5,6	95	11,8	12,1
Setts + filtercake	71	10,3	7,4	116	12,5	14,6
Mean	62	10,35	6,5	105	12,15	13,3
Sub-plots CV%	13,2	13,6	15,6	7,3	2,8	6,2
LSD (0,05)	10,5	1,91	1,31	10,2	0,48	1,13
(0,01)	14,4	2,62	1,80	14,0	0,66	1,54

TABLE VIII

Harvested crop characteristics of variety NCo 376 planted with and without filtercake

Treatment	Rainfed			Irrigated		
	stalks/ha (x 10^3)	Mean stalk length cm	Mean stalk diam. mm	Stalks/ha (x 10^3)	Mean stalk length cm	Mean stalk diam. mm
Setts	116	90	22,8	152	128	22,8
Setts + filtercake	126	108	24,3	169	150	23,4
Mean	121	99	23,5	160	139	23,1
Sub-plot CV%	10,2	10,7		5,5	6,2	
LSD (0,05)	15,1	14,0		10,8	12,0	
(0,01)	20,68	19,0		14,7	16,0	

TABLE IX

The effect of filtercake on yield of variety N 55/805 grown under rainfed and irrigated conditions

Treatment	Rainfed			Irrigated		
	tc/ha	ers%C	ters/ha	tc/ha	ers%C	ters/ha
Setts	63	10,8	6,7	113	13,5	15,3
Setts + filtercake	75	11,3	8,5	116	14,0	16,3
Mean	69	11,05	7,6	114,5	13,75	15,8
Sub-plot CV%	13,2	13,6	15,6	7,3	2,8	6,2
LSD (0,05)	10,5	1,91	1,31	10,2	0,48	1,13
(0,01)	14,4	2,62	1,80	14,0	0,66	1,54

Under irrigated conditions, however, high seed rates were associated with high yields. There is no evidence of a seed rate effect on ERS%C but the variability is high particularly in the rainfed treatments. The effect of seed rates on yield of variety N 55/805 are shown in Table V.

Under both rainfed and irrigated conditions the sugarcane yield from the setts and treble whole stick treatments were very similar and slightly higher than the sugarcane yield from the double whole stick treatment. The number of stalks per hectare and stalk length were greater with increasing seed rate, as shown in Table VI. The mean stalk diameter on the other hand declined with increasing seed rate particularly under irrigated conditions.

(ii) *Response to filtercake*

The effects of filtercake on yield of variety NCo 376 are shown in Table VII.

Confirming observations and measurements made during the growth of the crop, the yield response to filtercake was greatest under rainfed conditions. The percentage increase in yield of tc/ha from the use of filtercake was 34% under rainfed conditions and 18% under irrigated conditions. The increase in yield was due to more stalks per hectare which were both taller and thicker, as seen in Table VIII.

Variety N 55/805 did not respond to filtercake to the same extent as did NCo 376 — Table IX — but the pattern of response was similar. Under rainfed and irrigated conditions the increase in yield was 19% and 3% respectively.

(iii) *Response to soil consolidation*

There was no yield response with either variety, to consolidation over the planting row after covering the seedcane with soil. There was, however, a trend towards higher stalk populations with consolidation. It is considered that the method of consolidation was probably unsatisfactory in that the roller was excessively light.

(iv) *Response to irrigation*

During the period of crop growth 708 mm of rain were recorded and 339 mm of supplementary irrigation were applied to the irrigated block. Both varieties and all treatments responded substantially and equally to irrigation in a period of relatively low rainfall. The mean response to irrigation in all treatments for varieties NCo 376 and N 55/805 was 43 and 48 tc/ha, or 72 and 79 per cent increase respectively. On average 13 tc/ha was produced for 100 mm of supplementary irrigation.

Discussion

Under the conditions prevailing in this experiment the results show that similar or slightly greater yields can be achieved by planting whole sticks of relatively

young cane as opposed to the more common practice of planting setts. Being able to plant whole sticks alleviates the labour-demanding task of cutting stalks into setts and also simplifies techniques currently used for machine planting of seedcane. To ensure the elimination of apical dominance, an alternative planting system would be to place whole stick seedcane in the planting furrow and then cut into the setts prior to covering. The seedcane would have to be disease-free or the disease could be rapidly transmitted throughout the field.

Thompson and Halse[2] found that setts with nine eyes, which are comparable to the whole sticks used in the trial, gave a similar percentage germination to that of four-eyed setts. The yield results indicate, however, that if whole stick planting is to be practised, double whole stick could be used for NCo 376 but N 55/805 would require treble whole stick. The quantity of seed required for double whole stick planting is very similar to that required for planting standard-size setts with a 50% overlap.

Single whole stick gave low yields and could not be considered as a commercial planting practice even if used in conjunction with filtercake. Although these plant crop results indicate a linear yield response (at least with variety N 55/805) with increasing seed rates, it is probable that, as found by Boyce[3] in his work at Pongola, the effects will not persist into the ratoon crop.

The 11-month-old seedcane used in the trial is probably younger cane than normally used for planting material, and it is possible that older seed planted as whole stick would not have germinated as well.

It would appear that by planting either double or treble whole stick no real advantage over setts is achieved with regard to development of cane leaf canopy.

Roth[4] found that filtercake placed in the planting furrow will increase tillering, which gives rise to higher yields. This applied to both rainfed and irrigated conditions in the experiment.

The greater response under rainfed conditions may be due to the water-holding capacities of filtercake, the effects of which would be accumulated in a year of low rainfall. The higher yields and quicker formation of full leaf canopy where filtercake was used confirms that the material may be a valuable asset where a quick initial crop development is required, particularly when planting in a dry season and without irrigation. The rainfall during the cropping cycle was abnormally low for the region and hence a greater response to irrigation was achieved than would normally be expected in a year of more average rainfall.

Conclusions

Satisfactory yields can be achieved by planting NCo 376 using young double whole stick instead of setts, whereas variety N 55/805 appears to require treble whole stick to achieve similar yields to that obtained from using setts.

Filtercake applied in the furrow with setts was superior in its effect on cane yield than were all other treatments, but single whole stick with filtercake was inadequate.

Filtercake placed in the planting furrow will increase the rate of cane leaf canopy which may in turn reduce the need for weed control measures.

Acknowledgement

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