FIELD EXPERIMENTS TO TEST THE PERFORMANCE OF SUGARCANE TRANSPLANTS

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Abstract

The performance of sugarcane established as transplants has been compared with conventional sett planting in two series of field trials conducted since 1982. Results of the first series of four trials conducted on the Natal north coast are summarised. Factors considered were: inrow spacing, root plug size and season of planting. The effects of inrow spacing and root plug size were not statistically significant. Yields of transplants established in autumn were equal to those of conventionally planted cane while yields of spring planted transplants were variable. The second series of four trials was established in spring and included a wider range of sites and varieties. Varietal differences in yield were evident and quality of plant material was also an important factor. Performance of plant crops from transplants was generally inferior to that from conventional sett planting, but yields in subsequent ratoon crops, particularly those under irrigated conditions, were comparable.

Introduction

Transplanting of sugarcane plants is an alternative to the conventional sett planting methods used to establish seedcane and commercial crops. Modern transplanting techniques introduced to the forestry and vegetable industries in South Africa in the mid 1970s were adapted for sugarcane in 1981. The advantages of transplants as a useful option for seedcane nurseries have been reported (Thomas, 1984).

During the period 1982-86 the South African Sugar Association Experiment Station (SASEX) conducted a series of four trials at two sites on the Natal north coast to test the performance of sugarcane transplants. Factors included were inrow spacing, root plug size and season. The trials were located at the SASEX Central Field Station (CFS) at Umhlanga Rocks where the soil is a deep, red sandy loam of the Hutton form, and at La Mercy on a relatively shallow, grey loam soil of the Swartland form. The results (*Turner, unpublished data) of the plant and first ratoon crops were as follows:

- Yields of transplants spaced at 0,5 m and 0,75 m in the row were equal (row spacing 1,4 m). An increase in inrow spacing to 1,0 m reduced yields slightly (not statistically significant) and only in the plant crop. Experiments conducted in the Hawaiian sugar industry (Jakeway and Hewetson, 1989) showed that no significant yield reduction resulted when inrow spacing was increased to 1,5 m, but this was attributed in part to the fact that Hawaiian sugarcane is grown on a two year cycle and the second year's growth masked the effect of a low initial plant population.
- Two sizes of root plugs were tested. Transplants were established in models 72 and 98 polystyrene seed trays, with each compartment shaped like an inverted pyramid 100 mm deep and dimensions across the top of 51 × 51 mm and 43 × 43 mm respectively. Yields from these did not differ.
- The sucrose yields of the plant and first ratoon crops of transplanted sugarcane when compared with conventionally planted crops were:
  - equal at both sites when planting/harvesting took place in an autumn/winter cycle and equal at La Mercy in a spring/summer cycle. All crops were 15 months of age or older at harvest
  - reduced at the CFS site in a spring cycle crop which was harvested at 13 months of age. The quality of transplants was considered to be poor at the time of planting in the field.

Investigations into the potential of sugarcane transplanting have from time to time been conducted in other countries. Jakeway and Hewetson (1989) reported that two Hawaiian sugar companies were considering transplants as an alternative to their conventional planting operations. In the South African sugar industry, limited use has been made of transplants when commercial fields are established, but the concept has gained favour as an effective method for rapid propagation of seedcane in nurseries (Tucker, 1992). Several commercial nurseries have been established with an estimated capacity of five million plants.

Weed control has been recognised as a problem in transplanted cane. Trial results (**Leibbrandt, unpublished data) have indicated that the application of herbicides which include highly phytotoxic products is safe, if they are applied to trimmed back transplants at the stage of planting out in the field. Yield reductions have occurred as a result of delayed treatments.

A second series of four trials, designed to measure the performance of sugarcane established as transplants, was conducted by the Experiment Station during 1990-92 and included a wider range of sites and varieties. Yield results of plant and first ratoon crops, and one plant crop from a fourth trial are described in this paper.

Experiment procedure

Details of sites and selected details of trial procedures are presented in Table 1. Transplants were established at the Experiment Station and at commercial nurseries, and the age of transplants at the time of transplanting ranged from 12 to 15 weeks. Row spacing varied from 1,0 m to 1,4 m and a standard inrow spacing of 0,7 m was used. Trial design was randomised blocks and treatments were replicated five or six times. Plot sizes ranged from five to six rows of 8-10 m in length. One row on the side of each plot and 0,5-1,0 m of cane at the end of each plot was discarded for growth measurements, and measurements of yield at harvest. Cane in each plot was weighed at harvest and a sample of 12-16 stalks taken from each plot for sucrose analysis. Treatments for each experiment are indicated in the results.

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Table 1

Details of experiment sites and selected experimental procedures

Expt. No.	Site	Soil form	Cane variety	Rate of plant material		Moisture applied/received at planting		Transplant seed tray model	Month of planting	Water regime
				Convent.	Transplant	Convent.	Transplant			
				tc/ha	No./ha					
I	Pongola (SASA)	Hutton	NCo376 N14 N19 CP66/1043	± 10 ± 10 ± 10 ± 10	10 204 10 204 10 204 10 204	Irrigate 61 mm Irrigate 61 mm Irrigate 61 mm Irrigate 61 mm	Irrigate 61 mm Irrigate 61 mm Irrigate 61 mm Irrigate 61 mm	98 98 98 98	September September September September	Irrigation Irrigation Irrigation Irrigation
II	Umfolozi (Monzi)	Willow-brook	N14 N17 N19	± 10 ± 10 ± 10	10 204 10 204 10 204	Nil Nil Nil	± 0,6 l/plant ± 0,6 l/plant ± 0,6 l/plant	72 72 72	November November November	Rainfed Rainfed Rainfed
III	North coast (Hillhead)	Hutton	NCo376 N12 N21	± 10 ± 10 ± 10	12 987 12 987 12 987	Rainfall 89 mm Rainfall 89 mm Rainfall 89 mm	Rainfall 89 mm Rainfall 89 mm Rainfall 89 mm	98 98 98	September September September	Rainfed Rainfed Rainfed
IV	Midlands (Harburg)	Inanda	NCo376 N12 N16	± 12 ± 12 ± 12	14 285 14 285 14 285	Nil Nil Nil	2-3 l/m 2-3 l/m 2-3 l/m	98 98 98	September September September	Rainfed Rainfed Rainfed

Pre-emergence herbicides and repeated hand weeding were the standard weed control measures used, and post-emergence herbicides were applied to the interrow with the aid of a hand-held shield where necessary and feasible.

Results

Experiment I

Yield results are shown in Table 2. This trial was conducted under irrigated conditions on a deep, red sandy clay loam soil of the Hutton form. Transplants were obtained from a local commercial nursery with the exception of variety NCo376, which was established at the Experiment Station. In the plant crop, stalk population counts of transplants were consistently low (Figure 1) and this was reflected in statistically significant reductions in cane and sucrose yields at harvest. In the first ratoon crop the mean yields of transplants and conventional setts were equal. Plant and first ratoon yield results of a similar trial conducted under irrigated conditions by the Swaziland sugar industry during 1981-83 showed a similar trend (Leibbrandt, personal communication).

Table 2

Comparison of yields of transplants (TP) with conventional sett planting (C) in Experiment I (Pongola)

Treatment	Plant			Ratoon		
	Sept 90 - Oct 91 (12,3 months)			Oct 91 - Sept 92 (11,7 months)		
	tc/ha	ts/ha	TP as % of C (ts/ha)	tc/ha	ts/ha	TP as % of C (ts/ha)
NCo376 - C	145	19,6	100	151	21,2	100
NCo376 - TP	112	15,2	77	146	19,8	93
N14 - C	148	19,6	100	146	22,0	100
N14 - TP	126	16,5	84	154	21,8	99
N19 - C	129	17,5	100	147	21,1	100
N19 - TP	105	13,0	74	139	19,8	94
CP66/1043 - C	113	15,1	100	113	18,1	100
CP66/1043 - TP	79	10,7	71	112	19,0	105
LSD (0,05)	9	2,7	-	11	2,3	-
Mean - C	134	18,0	100	139	20,6	100
Mean - TP	105	13,9	77	137	20,1	98
LSD (0,05)	4	1,4	-	5	1,2	-

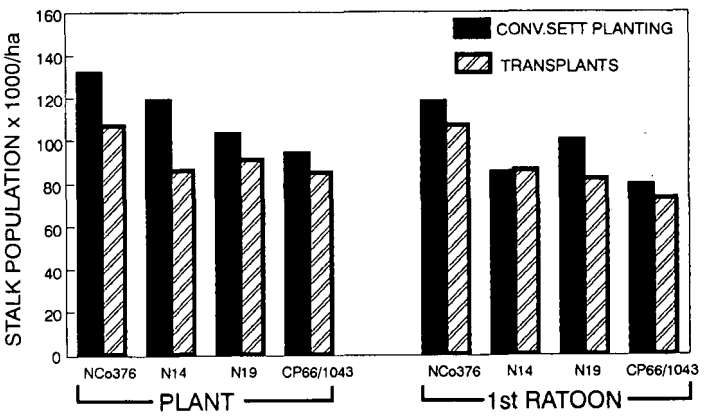

FIGURE 1 Comparison of stalk population at harvest of transplants with conventional sett planting in experiment I (Pongola)

Stool tipping, a side effect of lodging of the crop whereby cane stools tip out of the ground, was noted at harvest in the plant crop of transplanted cane and the influence of variety was evident. An assessment of the percentage and degree of stool tipping is shown in Table 3. The apparently higher degree of resistance to stool tipping displayed by variety N14 was noted also in work conducted in the Eastern Transvaal (*Donaldson, personal communication).

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Table 3

Assessment of percentage of stool tipping in plant crop transplants at harvest in Experiment I (Pongola)

Degrees of stool tipping	Variety			
	NCo376	N14	N19	CP66/1043
Slight to moderate < 45°	29%	25%	24%	26%
Moderate to severe 45°– 90°	40%	5%	51%	9%

In this trial there was no statistical evidence of an interaction between varieties and transplants.

Experiment II

Yield results are shown in Table 4. This trial was conducted on a shallow, black, blocky clay soil of the Willowbrook form in an area of the Monzi Flats which is subject to a fluctuating water table. Seed material was obtained from a local commercial nursery and transplants varied in quality; varieties N17 and N19 were mature with well developed root plugs, whereas those of N14 were immature with correspondingly poor root development.

Table 4

Comparison of yields of transplants (TP) with conventional sett planting (C) in Experiment II (Monzi)

Treatment	Plant			Ratoon		
	Nov 90 - Oct 91 (11,9 months)			Oct 91 - Oct 92 (11,5 months)		
	tc/ha	ts/ha	TP as % of C (ts/ha)	tc/ha	ts/ha	TP as % of C (ts/ha)
N14 - C	92	11,1	100	74	9,8	100
N14 - TP	88	9,8	88	59	7,4	76
N17 - C	86	11,8	100	82	12,2	100
N17 - TP	86	12,1	103	78	12,0	98
N19 - C	85	12,2	100	76	11,4	100
N19 - TP	77	11,0	91	72	10,8	95
LSD (0,05)	8	1,3	-	10	1,7	-
Mean - C	88	11,7	100	77	11,0	100
Mean - TP	84	11,0	94	70	10,1	92
LSD (0,5)	5	0,7	-	6	1,0	-

Statistically significant differences were evident in the performance of varieties planted as transplants. The sucrose yields of N17 in the plant and first ratoon crops from both planting methods were equal, while statistically significant yield reductions were recorded in both crops of transplanted N14. The quality of N14 transplants may in part have accounted for poor performance in the plant crop, and first ratoon yields showed that residual differences were maintained.

Stool tipping occurred only in the plant crop of N19, and crop measurements showed consistently lower stalk populations of transplanted cane in all varieties (Figure 2).

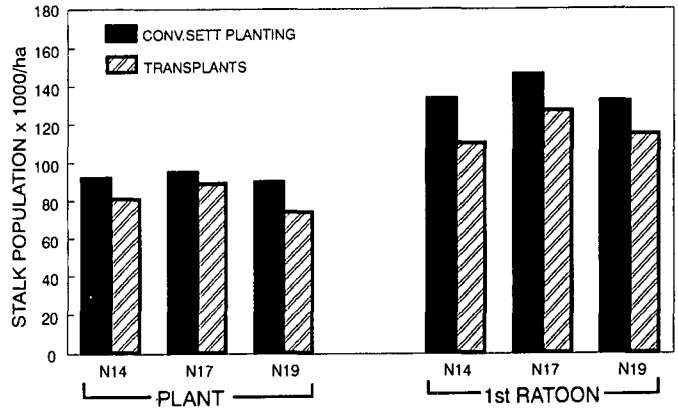

FIGURE 2 Comparison of stalk population at harvest of transplants with conventional sett planting in experiment II (Monzi)

Experiment III

This trial was conducted on a deep, loamy sand of the Hutton form. Transplants were established at the Experiment Station, and yield results are shown in Table 5.

Table 5

Comparison of yields of transplants (TP) with conventional sett planting (C) in Experiment III (Hillhead)

Treatment	Plant			Ratoon		
	Sep 90 - Nov 91 (14,0 months)			Nov 91 - Sep 92 (10,1 months)		
	tc/ha	ts/ha	TP as % of C (ts/ha)	tc/ha	ts/ha	TP as % of C (ts/ha)
NCo376 - C	82	11,5	100	38	5,2	100
NCo376 - TP	51	6,8	59	36	4,7	90
N12 - C	84	11,2	100	34	4,7	100
N12 - TP	34	4,2	38	24	2,8	60
N21 - C	66	9,2	100	35	4,8	100
N21 - TP	39	5,1	54	36	5,0	104
LSD (0,05)	25	3,6	-	24	3,6	-
Mean - C	77	10,7	100	36	4,9	100
Mean - TP	41	5,4	50	32	4,2	86
LSD (0,5)	15	2,1	-	14	2,1	-

Considerable damage to the leaves and shoots of newly established transplants was caused by hares and it was necessary to replant 20% of the crop within the first two months. Damage to the young conventionally planted cane was negligible. Results from an observation trial indicated yield losses of up to 80% in transplanted cane when the primary shoot was removed. Yield variability was considerable in the plant crop as a result of gaps and poor growth, and was compounded in the following crop by a severe drought and low cane yields. Lower stalk populations in all varieties of transplanted cane in the plant crop shown in Figure 3 may partly explain the statistically significant reductions in cane and sucrose yields at harvest. Results of the following crop cut at 10,1 months indicated that ratoon crop yields of NCo376 and N21 from both planting methods were comparable.

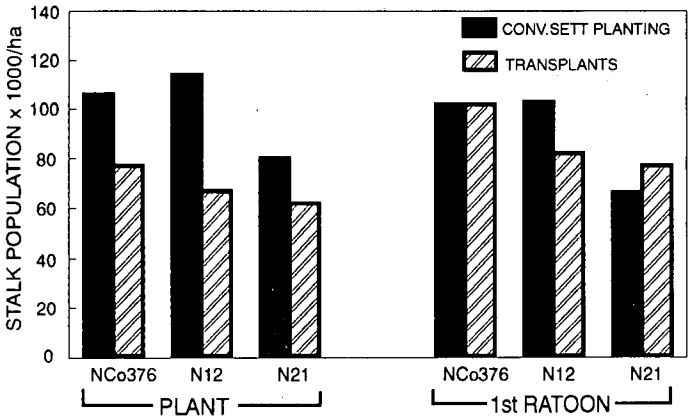

FIGURE 3 Comparison of stalk population at harvest of transplants with conventional sett planting in experiment III (Hillhead)

However, N12, a variety not normally favoured for harvesting when young, maintained the yield differences noted in the plant crop.

Experiment IV

This trial was conducted in the midlands on a humic soil of the Inanda form. Transplants were established at the Experiment Station. The plant crop results are shown in Table 6.

Table 6

Comparison of yields of transplants (TP) with conventional sett planting (C) in Experiment IV (Harburg)

Treatment	Plant		
	Oct 90 - Aug 92 (22,0 months)		
	tc/ha	ts/ha	TP as % of C (ts/ha)
NCo376 - C	114	18,0	100
NCo376 - TP	99	15,1	84
N12 - C	111	18,6	100
N12 - TP	93	15,5	83
N16 - C	121	20,0	100
N16 - TP	113	17,7	89
LSD (0,05)	18	2,9	-
Mean - C	116	18,9	100
Mean - TP	102	16,1	85
LSD (0,05)	10	1,6	-

Rainfall during the first year of the 22 month old crop was favourable, but extremely dry conditions prevailed during the second year of growth and up to harvest. Plant crop results followed the trend in the other trials, with significantly lower stalk populations (Figure 4) and reduced yields in transplanted cane compared with conventionally planted cane.

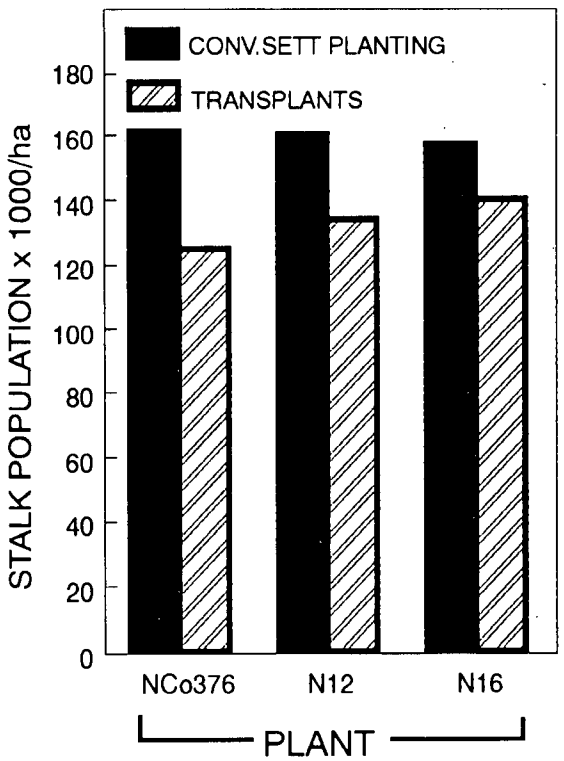

FIGURE 4 Comparison of stalk population at harvest of transplants with conventional sett planting in experiment IV (Hartburg)

Discussion and Conclusion

The performance of transplants was compared with that of conventionally planted cane in eight trials, six of which were established in spring and the balance in autumn. The results are summarised as follows:

- *Spring establishment.* Yields of the plant crops from transplants were inferior to conventionally planted cane in four trials, equal in one trial and variable in the other. Transplanted cane yields improved in the ratoon crops and, although varietal differences were evident, the yields from both treatments, particularly cane under irrigated conditions, were comparable.
- *Autumn establishment.* From a limited number of trials, indications are that yields of autumn planted transplants were equal to those of cane planted in the conventional manner.
- *Quality of transplants.* There is evidence to suggest that immature transplants, with poor root development at the time of planting, not only reduced plant crop yield but also adversely affected the first ratoon crop.

Acknowledgements

Gratitude is expressed to the Agronomy department staff and the co-operators concerned for their help and collaboration.

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