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Effects of Seedcane Size and Nitrogen Fertilizer on Crop Establishment, Growth and Yield of Sugarcane Variety Co 957

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ABSTRACT

Field experiments over two crop cycles (plant and first ratoon) were conducted at the research farm of the Unilorin Sugar Research Institute, Nigeria to evaluate the effects of four different seedcane sizes at four N levels on crop establishment, growth and yield of sugarcane variety Co. 957. Crop establishment measured as plant population density per hectare was better with seedcane longer than the conventional 2-3 budded setts at the two crop cycles. Highest cane (TCH) and sugar (TSH) yields were obtained by planting whole stalk seedcanes at both plant and ratoon crops. Crop establishment, TCH and TSH were not appreciably affected by N treatments at the plant crop, but were all significantly increased with increased N at the ratoon crop. The implications of differential response of plant and ratoon canes to N treatments were discussed, while it is suggested that planting sugarcane fields with young (7-8 months) whole stalks will be more economical.

INTRODUCTION

Presently, the conventional 2-3 budded setts are being used to plant commercial sugarcane fields in Nigeria with the attendant high cost of cutting and laying such setts. Thus, this high cost of cane production coupled with low tonnage of cane usually result in high cost of sugar. It is therefore imperative to find ways of reducing production cost as well as increasing yield to bring down the unit price of sugar. Recently, it has been suggested that the planting of the cane fields by whole stalks instead of the conventional 2-3 budded setts will not only reduce cost, but will also give better crop establishment thereby increasing the number of millable stalks (Ma, 1980). However, several workers have reported that top and middle sections of the whole stalk cut into setts germinate faster and better than the bottom sections (Clements, 1940; Plana and Alvarez, 1982; Abayomi, 1986; Matin *et al.*, 1988; Abayomi, *et at.*, 1990). These reports are therefore suggestive of increased top dominace effects which had been reported to be characteristic of setts longer than one-eyed setts (Singh and Ali, 1983), if matured whole stalks are planted with the top and middle section germinating faster thereby surpressing the lower buds. The proper use of fertilizer have been observed as another important factor of agronomic parctices (Pal, 1971). This proper application of fertilizers concerns not only their quality, but also their quantity, as too little of the right fertilizer does not give the most economic return while too much beyond the needs to the crop affects it adversely (Choudhry and Corpuz, 1984). It was therefore the objective of this study to investigate the desirability or otherwise of using setts longer than the conventional setts, especially whole stalk canes and the response to nitrogen fertilizer at plant and first ratoon crops.

MATERIALS AND METHODS

The study was conducted at the Unilorin Sugar Research Intitute's (USRI) farm with a commercial sugarcane variety Co 957. The experiment was designed as a 4^2 factorial laid out in split-plot arrangement with four replications. The main plot treatments which was cane seed size included (i) the conventional 2-3 budded setts, (ii) 5-6 budded setts, (iii) 8-10 budded setts and (iv) whole stalk seedcanes. Four levels of N fertilizer (75, 100, 125 and 150 kg N ha-1) constituted the sub-plot treatments. The N which was applied in two splits (1/2 at planting and 1/2 at 12 WAP) was in form of calcium ammonium nitrate (CAN=26% N). A basal application of K_2O and P_2O_5 @ 160 and 100 kg ha-1 respectively was made at planting.

Ratoon Crop Experiment : After the harvest of the plant crop experiment, the remaining trashes were manually removed from the plots and fresh randomization of the sub-pot treatments was carried out while the main plot treatments remained as they were at the plant crop. The N rates which were the same as for the plant crop were applied at 1 and 12 weeks after harvesting (WAH). All other cultural and agronomic practices were carried out as and when due during the two crop cycles. Crop establishment assessments were carried out as tiller counts at 8, 16 and 24 WAP at the plant crop and at 12 and 20 WAH at the ratoon crop. Yield components data were taken at harvest at 52 WAP and 50 WAH for the plant and ratoon crops respectively. Variance analyses were performed on all data and means were separated by DNMR test at 5% probability level ($p < 0.05$).

RESULTS AND DISCUSSION

The summary of results are presented in Tables 1, 2 and 3 for plant crop and 4 and 5 for the ratoon crop. Results show that seedcanes longer than the conventional 2-3 budded setts gave significantly better tiller density at 8, 16 and 24 WAP at plant crop (Table 1) and comparable plant population density at 12 and 20 WAH at the ratoon crop. While there were no significant effects of N levels on tiller density at any period at plant crop (Table 1), plant population was significantly increased at 12 WAH by the application of higher N rates at the ratoon crop. While there were no significant effects of N levels on tiller density at any period at plant crop (Table 1), plant population was significantly increased at 12 WAH by the application of higher N rates at the ratoon crops (Table 4). Yield components such as stalk length and diameter, number of internodes per stalk were not significantly affected by neither seedcane size nor N levels at both the plant (Table 2) and the ratoon (Table 4) crops. Similarly, number of millable stalks was not significantly affected by seed cane size at both crop cycles. However, number of millable stalks increased with N application at both plant and ratoon crop cycles with significant differences only at the plant crop (Tables 3 and 5). Cane yield (TCH) increased with sett sizes, the differences were however not significant at any of the crop cycles. Similarly, TCH was not significantly affected by N treatments at plant crop (Table 3), but was significantly increased by higher N rates at the ratoon crop (Table 5), suggesting a higher fertilizer requirements for ratoon crops. The quality of cane was measured as percent sugar in juice (brix) and tonnes sugar per hectare (TSH). Neither the seedcane size nor N treatments significantly affected % brix. Nevertheless, TSH was significantly increased by increased N application at the ratoon crop reflecting the effects of the treatments on cane tonnage. The results of the two crop cycles in this study show that there is no added advantage to sugarcane growth and yield by cutting stalks into smaller setts, but instead it increases labour cost. The conventional 2-3 budded setts gave an average yield (TCH) of 36.83 as against 41.2

obtained from planting the field with whole stalks, and 49.35 as against 52.21 for the same setts respectively at the ratoon crop. The rasults of this study were therefore in agreement with the suggestion of Ma (1980) that planting sugarcane with whole stalk canes will not only reduce cost, but also increase yield. The increased plant population and therefore TCH may be due to reduction in the level of the undesirable gaps that usually result from the death of growing seedlings due to termite infestation and or/ early exhausion of food reserves in smaller setts (Singh and Ali, 1983). The envisaged

Table 1. Effects of seedcane size and nitrogen fertilizer on plant population density of plant crop at 8, 16 and 24 WAP.

	Plant population density (x 10^3 ha^{-1})		
	8 (WAP)	16 (WAP)	24 (WAP)
Seedcane size			
2-3 budded setts	38.88a*	51.82a	105.12a
5-6 budded setts	52.65b	88.90b	111.25ab
8-10 budded setts	66.34c	115.62c	118.70b
whole stalk canes	66.84c	119.75c	115.92b
N levels (kg N ha^{-1})			
75	52.62a	92.76a	105.00a
100	59.15b	96.25a	112.25b
125	55.22ab	95.82a	114.29b
150	57.73b	91.58a	119.46b

* All means within each column carrying the same alphabet are not significantly different at 5% level of probability by the DNMRT test.

Table 2. Effects of seedcane size and nitrogen fertilizer on yield components of plant crop.

	Stalk length (cm)	Stalk diameter (cm)	Internodes (No.)
Seedcane size			
2-3 budded setts	129.05a*	7.38ab	17.5a
5-6 budded setts	134.73ab	7.19a	16.5a
8-10 budded setts	137.85b	7.51b	18.2a
whole stalk canes	134.45ab	7.18a	17.0a
N levels kg (N ha^{-1})			
75	135.67a	7.56a	17.9a
100	133.63a	7.26b	17.7a
125	133.20a	7.23b	17.0a
150	133.57a	7.20b	16.6a

* All means in the same column carrying the same alphabet are not significantly different at 5% level of probability by DNMRT test.

Table 3. Effects of seedcane size and nitrogen fertilizer on cane yield and juice quality of plant crop.

	Millable stalks ($\times 10^3$ ha^{-1})	% Brix	TCH	TSH
Seedcane size				
2-3 budded setts	75.33a*	21.0ab	33.60a	7.03a
5-6 budded setts	85.37a	21.4a	36.83a	7.92a
8-10 budded setts	86.54a	20.3b	37.62a	7.61a
whole stalk canes	82.83a	21.2ab	41.21a	8.76a
N levels (kg N ha^{-1})				
75	75.54a	21.4a	38.96a	8.32a
100	81.33b	21.1ab	38.04a	8.07a
125	82.54b	20.7b	38.54a	7.90a
150	90.66c	20.7b	38.62a	8.03a

* All means within each column carrying the same alphabet are not significantly different at 5% level of probability by the DNMRT test.

Table 4. Effects of seedcane size and nitrogen fertilizer on growth of the first ratoon crop.

	Plant population ($\times 10^3$ ha^{-1})		Stalk length (cm)	Stalk diameter (cm)
	12 (WAP)	20 (WAH)		
Seedcane size				
2-3 budded setts	118.38a*	141.56a	193.44a	7.29a
5-6 budded setts	130.46ab	159.12ab	195.56a	7.75a
8-10 budded setts	130.26ab	166.96ab	188.38a	7.54a
whole stalk canes	140.32b	174.91b	208.32a	8.35a
N levels (kg N ha^{-1})				
75	109.7a	152.24a	185.78a	7.72a
100	126.4b	157.41a	190.19a	7.63a
125	134.4c	163.35a	196.85a	7.75a
150	148.7c	169.35a	212.88a	7.82a

* All means within each column carrying the same alphabet are not significantly different at $p < 0.05$ by DNMRT test.

top dominance effect reportedly associated with planting of setts longer than one-eyed setts (Singh and Ali, 1983) was not observed in this study. This was probably due to the fact that relatively younger canes (7-8 months) were planted with the field receiving adequate moisture soon after planting. It is therefore suggested that planting fields with relatively young whole stalk canes can reduce labour cost and improve yield.

Table 5. Effects of seedcane size and nitrogen on cane yield and juice quality of plant crop.

	Millable stalks (x 10^3 ha^{-1})	% Brix	TCH	TSH
Seedcane size				
2-3 budded setts	88.2a	19.7a	45.34a	9.05a
5-6 budded setts	102.8a	19.3a	49.38a	9.55a
8-10 budded setts	97.3a	20.2a	49.02a	9.88a
whole stalk canes	99.2a	19.1a	52.21a	9.99a
N levels (kg N ha^{-1})				
75	93.8a	19.9a	34.34a	6.85a
100	93.6a	19.0a	44.55b	8.45b
125	96.4a	19.8a	56.04c	11.12c
150	103.6a	19.6a	61.52c	12.08c

* All means within each column carrying the same alphabet are not significantly different at $p < 0.05$ by DNMRT test.

The significant effects of N treatments at the ratoon crop but not at the plant crop suggested that fertilizer requirements of ratoon crops are greater than that of the plant crop. This observation was in line with the report of Borden (1944) who had earlier shown that plant crops need for optimum yield less than two pounds (< 1 kg) of N per ton of cane, whereas ratoons required 2.5 lbs (> 1 kg). This is reportedly due to the fact that plant crop appears to be more efficient users of fertilizer than ratoon canes (Humbert, 1968), because the deteriorating soil structure and poor aeration limit the effectiveness of the root systems of the ratoon crops (Humbert, 1959). Applying the same rates of fertilizer to plant and ratoon crops is therefore more likely to be responsible for the reportedly sharp decline in yield of ratoon crops (Oworu, 1988). It is, therefore, suggested that N application should increase with progressive ratoon cycles for optimum yield at each successive ratoon.

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