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Growth, Yield and Quality of Sugarcane (*Saccharum officinarum* L.) As Affected by Different Levels of NPK Applications

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Abstract

Response of three sugarcane cultivars namely BL-4, SPSG-26 and SPSG-394 to NPK levels of 0-0-0, 200-0-0, 200-150-150 and 200-200-200 kg was studied under field conditions. Variety SPSG-394 gave the highest cane yield of 107.67 tons ha^{-1} compared to 88.85 and 58.53 tons ha^{-1} for the varieties BL-4 and SPSG-26, respectively. An increase of 16.27 and 26.13 tons ha^{-1} over control was recorded with the application of 200 kg N ha^{-1} alone and 200-150-150 kg NPK ha^{-1}, respectively, Sucrose contents and commercial cane sugar were not affected significantly by fertilizer application. However, variety SPSG-26 gave significantly higher sucrose contents (18.82%) and commercial cane sugar (12.89%) than SPSG-394 and BL-4. The fertilizer application at 200-150-150 kg NPK ha^{-1} was found to be optimum level for achieving maximum cane yield.

Introduction

Sugarcane (*Saccharum officinarum* L.) is not only an important sugar crop but also a source of raw material for various agro-based industries in Pakistan. It is grown on an area of 0.963 million hectares with annual stripped-cane production of 44.63 millions tons, giving an average cane yield of 46.16 t ha^{-1} (Anonymous, 1997). Average cane yield however, is much lower than the achievable potential of our existing sugarcane varieties. Ahmad (1988) suggested that cane tonnage and sugar production per hectare can be increased by the use of high yielding varieties. Genotypic differences in cane length, cane girth, weight per cane, number of mailable canes, cane yield, sucrose contents and commercial cane sugar percent have been reported by Khalid (1996) and Sharar *et al.* (1998). Yield potential of sugarcane varieties grown by the farmers, however, is rapidly deteriorating due to changes in edaphic and climatic factors and changing patterns of insects, pest and diseases (Malik, 1990).

The exhaustive nature of sugarcane crop demands an adequate and balanced supply of nutrients for its increased yield (Ingawale *et al.,* 1992). Rahman *et al.* (1992) reported that the application of 150 kg N ha^{-1} as urea, 52 kg P ha^{-1} as triple super phosphate and 83 kg K ha^{-1} as muriate of Potash produced cane yield of 99.21 tons ha^{-1} and sugar yield of 8.63 tons ha^{-1} and gave the highest returns as compared to other rates of fertilizer application. The effect of fertilizer application on sucrose contents in sugarcane is some what controversial. Significant decrease in sucrose content with nitrogen application have been reported by Asghar (1978) and Parashar *et al.* (1980). Zulfiqar (1984) found that 100 kg N ha^{-1} and 50 kg P ha^{-1} alone or in combination did not improve the sucrose contents in sugarcane. Non significant effects of fertilizer application on commercial cane sugar percent have also been reported by Sarwar *et al.* (1996). However, significantly improved sucrose contents with the application of 250 kg N ha^{-1} plus 32 kg P ha^{-1} have been reported by Jayabal and Chockalingam (1990). The present study was, therefore, planned to evaluate the effect of different NPK levels on three improved varieties of sugarcane and also to determine the optimum NPK level for best performing variety under Faisalabad condition.

Materials and Methods

This project was conducted at the Post-graduate Agricultural Research Station (PARS), University of Agriculture, Faisalabad, on a sandy clay loam soil, during the year 1993-94. Four fertilizer levels (0-0-0, 200-0-0, 200-150-150, 200-200-200 kg NPK ha^{-1}) and three varieties (SPSG-26, BL-4 and SPSG-394) were used for this study. The experiment was laid out in split plot design with four replications and a net plot size measuring 4 x 3.6 m. Crop was planted on September 27, 1993 and harvested in the last week of December, 1994. The fertilizer were applied in the form of Urea, DAP (diammonium phosphate) and SOP (sulphate of potash). Half of nitrogen and whole of phosphorus and potash was applied at planting time, while remaining half of nitrogen was applied at the end of December. All other agronomic practices were normal and uniform for all the treatments. Number of mailable canes per unit area, cane length and diameter, weight per cane and yield ha^{-1} were recorded using standard procedures. Sucrose percentage was determined by Horn's dry lead acetate method of sugarcane analysis. The data was analyzed statistically using Fisher's analysis of variance technique and the differences among treatment's means were compared using the LSD test at 5 percent probability level (Steel and Torrie, 1984).

Results and Discussion

Number of mailable canes produced per unit area (m^2) were significantly different among varieties. SPSG-394 produce

Table 1: Effect of NPK application on cane yield, yield components and sucrose contents of three sugarcane varieties.

	Varieties		NPK rates (kg ha^{-1})				
Parameters	SPSG-26	BL-4	SPSG-394	0-0-0	200-0-0	200-150-150	200-200-200
No. of mailable canes (m^{-2})	8.67c	10.83b	13.25a	10.04b	10.54b	11.57a	11.51a
Cane length (m)	2.00c	2.18b	2.27a	2.03b	2.15b	2.21a	2.22a
Cane diameter (cm)	2.23b	2.40a	2.24b	2.10c	2.31b	2.31b	2.43a
Weight cane^{-1} (kg)	0.68b	0.82a	0.81a	0.68c	0.81ab	0.82a	0.78b
Stripped cane yield (t ha^{-1})	58.53c	88.85b	107.67a	69.49c	85.76b	92.62a	89.20b
Harvest index (%)	73.59b	77.26a	73.95b	72.17c	75.08b	77.20a	75.28b
Sucrose contents (%)	18.82a	17.13c	17.74b	17.98NS	18.01	17.84	17.75
Commercial cane sugar (%)	12.89a	11.60c	12.08b	12.27NS	12.34	12.11	12.02

Any two means in column not sharing a letter in common differ significantly at probability = 0.05

the maximum number (13.25) of mailable canes and significantly lowest number (8.67) was recorded for variety SPSG-26 (Table 1). The differences in mailable canes can be attributed to varied inherent potential of the varieties. Similar results have been reported by Ahmad *et al.* (1990), Khalid (1996) and Sharar *et al.* (1998). Mailable canes were also affected significantly by fertilizer treatments. Overall, application of NPK at 200-150-150 kg ha^{-1} produced significantly higher number (11.57) of mailable canes m^{-2} as compared to control (10.04) and nitrogen alone. The differences between NPK rate of 200-150-150 and 200-200-200 Kg ha^{-1} were not significant. The number of mailable canes recorded in control and nitrogen were also statistically similar. The results are in conformity with those of reported by Asghar (1978). Cane length and diameter were also significantly affected by varieties as well as fertilizer rates. Significantly longer canes (2.27 m) were observed in variety SPSG-394, whereas the variety SPSG-26 produced canes of lowest length (2.00 m). These findings are in line with those of Ahmad *et al.* (1990) and Sharar *et al.* (1998). All fertilizer levels remaining at per with each other produced significantly longer canes than control. The maximum cane length (2.22 m) was observed from plots receiving NPK at 200-200-200 kg ha^{-1}.

Variety BL-4 produced significantly thicker canes (2.40 cm) than in SPSG-26 and SPSG-394. The varieties SPSG-26 and SPSG-394 have statistically similar stem diameter. Significant varietal differences in stem diameter have also been reported by Khalid (1996) and Sharar *et al.* (1998). The plots receiving NPK at 200-200-200 kg ha^{-1} NPK produced significantly thicker canes (2.43 cm) than other fertilizer levels. The differences between N alone and NPK rates of 200-150-150 kg ha^{-1} were not significant. The minimum cane diameter (2.10 cm) was recorded in control. These results are quite in line with those of Nazir *et al.* (1987).

Variety BL-4 produced significantly heavier canes (0.82 kg) than SPSG-26 (0.68 kg) but remained at par with SPSG-394 (0.81 kg). Significant differences in weight per cane have also been reported by Ahmad *et al.* (1990), Khalid (1996) and Sharar *et al.* (1998). Maximum weight per cane (0.82 kg) was recorded in plots fertilized at 200-150-150 kg NPK ha^{-1} which remained at par with fertilizer rate of 200 kg N ha^{-1} (0.81 kg). The minimum cane weight was recorded in control (0.68 kg). These results are in conformity with those of Asghar (1978) and Nazir *et al.* (1987).

It is evident from the data given in the Table 1 that varieties varied significantly for stripped cane yield. The variety SPSG-394 produced significantly highest cane yield (107.68 t ha^{-1}) followed by the variety BL-4 which gave cane yield of 88.85 t ha^{-1}. The variety SPSG-26 gave significantly the lowest cane yield (58.53 t ha^{-1}). Many earlier workers have reported significant yield differences among the varieties (Ahmad *et al.,* 1990; Khalid, 1996; Sharar *et al.,* 1998). Regarding fertilizer treatments significantly higher cane yield (95.62 t ha^{-1}) was recorded in plots fertilizer at 200-150-150 kg NPK ha^{-1} and the lowest cane yield (69.49 t ha^{-1}) was obtained from control plots. Non significant differences were observed between nitrogen alone and NPK at 200-200-200 kg ha^{-1}. These results are in agreement with those of Zulfiqar (1984), Nazir *et al.* (1987) and Rahman *et al.* (1992).

The harvest index is an indication of the productive efficiency of a crop. Significant differences were observed among the varieties for harvest index and values were 77.26, 73.59 and 73.95 percent for variety BL-4, SPSG-26 and SPSG-394, respectively. For fertilizer application, significantly higher harvest index value (77.20%) was recorded in plots fertilized at 200-150-150 kg NPK ha^{-1} and lowest in control (72.17). These results are supported by Ahmad *et al.* (1990).

It is evident from the data that varieties differed significantly in sucrose contents in cane juice. Significantly highest sucrose contents (18.82%) were recorded in variety SPSG-26 and lowest (17.13%) in variety BL-4. These results are in conformity with Ahmad *et al.* (1990), Khalid (1996) and Sharar *et al.* (1998). Sucrose contents were not affected by fertilizer application. Commercial cane sugar percent has the similar trend as sucrose contents in cane juice and values recorded were less than 12.90 percent and 12.40 percent for varieties and fertilizer levels, respectively. Results reported by Sarwar *et al.* (1996), Sharar *et al.* (1998) and Khalid (1996), are in conformity with these findings.

In this study the fertilizer application at 200-150-150 kg

NPK ha^{-1} was found to be optimum level for achieving maximum cane yield. Among the varieties, SPSG-394 proved to be the best.

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