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Morpho-Qualitative Traits of Autumn Planted Sugarcane as Influenced by Seeding Density and Nutrient Management

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ABSTRACT

Studies pertaining to the response of autumn planted sugarcane to seedling density and nutrient management were conducted at the University of Agriculture, Faisalabad. The seedling density comprised 50,000 and 100,000 two budded setts ha^{-1}, while the fertilizer treatments were 0-0-0, 75-100-100, 100-100-100 and 125-100-100 kg NPK ha^{-1}. The crop was planted in 90 cm spaced double-row strips (30/90 cm) during the second week of September and harvested on December 15 next year. The seeding density in each treatment was maintained by placing single and double-row of seed setts in each furrow. The relatively more number of millable canes m^{-2} was recorded in crop seeded @ 100,000 two-budded setts ha^{-1} than that @ 50,000 setts ha^{-1}. Similar cane yield was obtained with the application of 100-100-100 or 125-100-100 kg ha^{-1} NPK. By contrast, the sucrose content in cane juice was not influenced significantly both by seeding density and fertilizer application which on an average varied from 16.22 to 16.92%.

Key Words: Morpho-Qualitative Traits; Seeding density; Nutrient Management; Autumn Planted Sugarcane

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is a crop of tropical origin with perennial habits and high sucrose content. However, its cultivation has successfully been extended to subtropics because of its wider ecological adaptability and tolerance to high temperature. It requires a temperature of above 20 °C to thrive and a period of about eight to twenty four months to reach maturity depending upon the agro-climatic conditions to which it is subjected. Sugarcane supplies over 80% of the world sugar and plays a remarkable role in the economic uplift of the growers and the country by earning lot of foreign exchange and providing employment to millions of people. In Pakistan it is cultivated on an area of about 1056 thousand hectares with total annual production of 53104 thousand tonnes of cane giving an average cane yield of 50.3 t ha^{-1} with 8.5 per cent of white sugar recovery (Anonymous, 1997).

Inspite of all-out efforts of both the breeders and the agronomists its per hectare harvested yield is still much lower than that obtained at research stations. This gap between the harvests and potential yield is attributable to poor agro-management practices and malnutrition especially at small farm level. Among the agronomic practices, low seeding density and improper use of fertilizer are considered to be the major constraints in the normal production of sugarcane. Hence there is need to develop an appropriate production technology of sugarcane particularly in relation to optimum planting density and fertilizer management. Consequently the present study was planned to determine the effect of different seeding density and NPK rates on the morpho-qualitative traits of autumn planted sugarcane under the agro-ecological conditions of Faisalabad in irrigated environments.

MATERIALS AND METHODS

In a field experiment the effect of different NPK combinations and seeding densities on cane yield and juice quality of autumn planted sugarcane cultivar Coj-64 was determined on a sandy-clay loam soil at the University of Agriculture, Faisalabad during the year 1990-91. The experiment was laid out in a randomized complete block design with split arrangement and four replications. The net plot size measured 7.20x9 m. The NPK levels were randomized in the main plots and the seeding densities in the sub-plots. The fertilizer treatments comprised 0-0-0, 75-100-100, 100-100-100 and 125-100-100 kg NPK ha^{-1} while the seeding densities were 50,000 and 100,000 two-budded setts ha^{-1} maintained as single and double-row of setts in each furrow, respectively. The crop was planted in 90 cm spaced double-row strips (30/90 cm) during the second week of September and harvested on December 15 next year. All the P and K along with half of N in the form of diammonium phosphate (DAP), potassium sulphate (SOP) and urea, respectively was applied at the time of planting while the remaining half of N was top-dressed at the completion of tillering.

All other agronomic practices were kept normal and uniform in all the treatments. In all 20

irrigations each of 10 cm were applied throughout the growing period of the crop. Observations on desired parameters were recorded using standard procedures. Sucrose percentage in cane juice was determined by Horn's dry lead acetate method of sugar analysis. Commercial cane sugar percentage was computed by using the Clayton Equation (1959).

$$C.C.S.\%age = \frac{3P}{2}\left(1-\frac{F+5}{100}\right)-\frac{B}{2}\left(1-\frac{F+3}{100}\right)$$

$$C.C.S.\left(t\ ha^{-1}\right) = \frac{C.C.S.\%age \times Cane\ yield\ ha^{-1}}{100}$$

Where

C.C.S. = Commercial cane sugar
P = Pole percentage (Sucrose%age)
B = Brix percentage
F = Fibre percentage

The data collected were statistically analysed by using Fisher's analysis of variance technique and the treatment means were compared by LSD test at 0.05 P (Steel & Torrie, 1984).

RESULTS AND DISCUSSION

Data regarding the various agro-qualitative traits are presented in Table I.

Cane density m^{-2} at harvest. Application of NPK in different combinations had no significant effect on cane density m^{-2} recorded at harvest which on the average varied from 15.04 to 15.83 millable canes m^{-2}. These results are not in line with those of Nazir *et al.* (1987) who reported an increase in cane density m^{-2} with the application of NPK in different combinations. Similarly cane density m^{-2} was not influenced significantly by seeding density. Interaction SxF was also non-significant. These results are not in consonance with those of Mathur and Bhadauria (1968), Singh *et al.* (1982) and Nazir *et al.* (1987) who reported that higher planting rate resulted in greater number of canes m^{-2}.

Weight per stripped cane. Weight of an individual cane has a direct bearing on the final cane yield ha^{-1}. Data on weight per cane revealed that fertilizer application significantly increased the cane weight over check. However, the difference among the fertilizer rates were non-significant. Similar results were reported by Iftikhar (1985). By contrast, the different seeding rates had no significant effect on wight per cane which on the average varied from 0.78 to 0.82 kg. These results are in line with those reported by Gill and Alam (1967), Khalid (1979) and Iftikhar (1997).

Stripped cane yield ha^{-1}. There were significant differences among the different fertilizer rates and seeding densities. Although the cane yield increased significantly with each successive dose of NPK over check but the difference between 100-100-100 and 125-100-100 kg NPK ha^{-1} rates was non-significant which gave cane yield of 132.06 and 132.46 t ha^{-1}, respectively. This clearly indicated that sugarcane variety COJ-64 did not show significant response to fertilizer application beyond the level of 100-100-100 kg NPK ha^{-1}. Increase in cane yield with the application of NPK fertilizer has also been reported by Lakhdive (1979), Kadian *et al.* (1981), Nazir *et al.* (1987) and Afghan (1997).

By contrast, planting density effects on cane yield ha^{-1} were non-significant. These results are not in line with those of Nazir *et al.* (1985) and Bashir (1997) who reported increase in cane yield with an increase in seeding rate.

Sucrose content in cane juice. Cane maturity and its quality are generally determined by sucrose content in cane juice. Although there were visible difference among the various fertilizer treatments and seeding rates but the differences were statistically non-significant. However, higher seeding density and NPK application @ 100-100-100 kg ha^{-1} tended to increase the sucrose content in cane juice. On the whole the sucrose content in cane juice varied from 16.22 to 16.92%. Similarity in the results under the different fertilizer and seeding density treatments was probably attributed to normal cane growth and development which controlled excessive growth and ultimately resulted in uniform maturity of the cane. These results are corroborated with those of Nazir *et al.* (1987), Mahmood (1988), Bashir (1997) and Afghan (1997).

Commercial cane sugar (C.C.S.). Commercial cane sugar percentage indicates the magnitude of sugar recovery and is directly proportional to the sucrose content in cane juice. Different fertilizer and seeding density rates did not influence the C.C.S. percentage to a significant extent which on the average varied from 12.28 to 13.15 in case of fertilizer treatments and from 12.63 to 12.67 for seeding density treatments. Similar results were reported by Dhoble and Khuspe (1983), Nazir *et al.* (1987) and Bashir (1997).

Harvest index. Although harvest index was variable under the different fertilizer and seeding density treatments yet the differences among them were non-significant. The harvest index on the average ranged between 75.84 and 78.75%. This was probably

Table I. Agronomic traits and sucrose content in cane juice of autumn planted sugarcane as affected by seeding density and nutrient management

Treatment				Cane density (m^{-2})	Weight/cane (kg)	Cane Yield (t ha^{-1})	Tops weight (t ha^{-1})	Cane-top ratio	Harvest index (%)	Sucrose content	C.C.S. (%)
A. Seedling density (S) (two-budded setts ha^{-1})											
S_1 = 50,000				15.12^{NS}	0.79	118.94^{NS}	20.36^{NS}	5.84^{NS}	77.39^{NS}	16.70^{NS}	12.97^{NS}
S_2 = 100,000				15.74	0.77	121.49	19.34	6.81	77.57	16.49	12.83
B. Fertilizer Rate (F) (kg ha^{-1})											
	N	**P**	**K**								
F_0	0	0	0	15.04^{NS}	0.58^{NS}	87.51 c	17.03 b	5.14^{NS}	75.84^{NS}	16.68^{NS}	12.78^{NS}
F_1	75	100	100	15.43	0.83 a	128.09 b	21.30 a	5.01	77.12	16.56	12.97
F_2	100	100	100	15.83	0.84 a	132.06 a	20.47 a	6.45	78.20	16.92	13.15
F_3	125	100	100	15.81	0.83 a	132.46 a	20.04 a	6.61	78.75	16.22	12.72
C.	SxF			NS	NS	NS	NS	NS	NS	NS	NS

Any two means in a column not sharing a letter differ significantly at P = 0.05 (LSD)
NS = Non-significant

ascribed to almost uniform pattern of growth in all the treatments under study.

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