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Effect of nitrogen application on juice quality and sugar yield in sugarcane varieties

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ABSTRACT

A field experiment was conducted at Lakhaoti during 1993–94 and 1994–95 to assess the impact of nitrogen levels (0,60, 120, and 180 kg/ha) on juice quality and sugar yield of some promising sugarcane genotypes ('Co 1148', 'CoS 767', 'CoS 687' and 'CoJ 64') planted in spring season. Genotypes differed significantly in terms of per cent extraction brix, sucrose, purity, available sugars, reducing sugars, millable canes, cane yield, and commercial cane sugar (CCS) yield. 'CoJ 64' had the best quality, followed by 'CoJ 687', 'Co 1148' and 'CoS 767'. However, the highest sugar yield was recorded with 'Co 1148'. Nitrogen had an adverse effect on juice-quality attributes. The highest commercial cane sugar yield was obtained with 120 kg N/ha and it declined by 8.2% with further higher dose of 180 kg/ha.

Key words : Sugarcane, Genotypes, Nitrogen, Yields, Quality

Sugarcane is an integral part of predominant cropping systems, being followed in Uttar Pradesh and Uttaranchal. Before formation of Uttaranchal, Uttar Pradesh alone covered more than 50% of national cane acreage, though the production dwindles around 40%. The recovery of sugar is further low compared to southern parts of India. Selection of suitable genotypes and adequate nitrogen fertilization may bridge this gap in production and area. Nitrogen increases cane yield but simultaneously it depresses juice quality. Hence its judicious use is needed. Screening of genotypes for their suitability under different agroclimatic conditions is also indispensable for higher productivity. Thus the present investigation was undertaken to test the performance of some promising sugarcane genotypes and their nitrogen demand under western Uttar Pradesh conditions.

MATERIALS AND METHODS

The field experiment was conducted during 1993–94 and 1994–95 at Lakhaoti,

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characterized by subtropical climate, on sandy-loam soil, low in organic carbon, medium in available P and K, with pH 7.6. Sixteen treatments comprising 4 genotypes ('Co 1148', 'CoS 767, 'CoS 687' and 'CoJ 64') and 4 nitrogen levels (0,60, 120, and 180 kg/ha) were replicated thrice in randomized block design. Crop was planted in February in furrows 75 cm apart. Half of N (urea) and full dose of P (single superphosphate) and K (murate of potash) were applied basal. Remaining N was given 80 days after planting. Other inputs and operation were practised as per recommendations. Crop was harvested in the first fortnight of March and juice was analysed for quality using standard methods. Available sugar and commercial cane sugar yield were computed as : Available sugar (%) = [S (B–S) 0.4] × 0.73 where S = sucrose content (%) and B = corrected brix

$$\text{Commercial cane sugar (tonnes/ha)} = \text{Cane yield (tonnes/ha)} \times \frac{\text{available sugar (\%)}}{100}$$

RESULTS AND DISCUSSION

Varieties

Varieties differed significantly for extraction (%) and brix (Table 1). Juice pH did not vary markedly. 'CoJ 64' recorded the highest extraction (%) and brix, followed by 'CoS 687' and 'Co 1148', though the differences were significant only between 'CoJ 64' and 'CoS 767'. The former also had highest sucrose and proved superior to 'Co 1148' and 'CoS 767' for sucrose and available sugar content and juice purity (Table 2). Reducing sugars were lowest in 'CoJ 64' and highest in 'CoS 767'. Rana and Saini (1989) also reported genotypic variations in juice quality.

Among genotypes, 'Co 1148' gave 1.0, 18.7 and 23.0% more yield than 'CoS 767', 'CoS 687' and 'CoJ 64', attributing to higher number of millable canes. 'Co 1148' outyielded 'CoS 687' and 'CoJ 64' by 11.9 and 10.5% for commercial cane sugar yield, primarily because of its higher cane yield that could not be neutralized by better quality of 'CoS 687' and 'CoJ 64'. 'CoS 767' remained on a par with 'Co 1148' and 'CoJ 64' during both the years, but outyielded 'CoS 687' by 7.8% during 1993–94 owing to high cane tonnage. Moreover, 'Co 1148' and 'CoS 767' got enough time to attain maturity and thereby led to narrowing of quality differences with 'CoS 687' and 'CoJ 64'. Das *et al.* (1997) did also notice similar varietal differences.

Nitrogen

Nitrogen fertilization had significant effect on juice extraction and brix (Table 1); both exhibited an increasing trend with increasing N levels except that no N application resulted in higher brix. This might have been due to improved uptake of water by plants, as nitrogen supply is often associated with increase in water status of plants. Brix, a measure of total soluble solids, might have shown an increase beyond 60 kg N/ha owing to increased uptake of nutrients and their accumulation in shoots, as also evident from purity coefficient (Table 2) which followed a reverse trend. Without nitrogen, brix might have been highest due to more biosynthesis of sucrose and low activity of invertase enzyme responsible for its degradation. Sucrose content and reducing sugars also confirmed these facts. Since enzymes are

Table 1. Extraction, pH, brix, sucrose and purity of juice as influenced by varieties of sugarcane and nitrogen application

Treatment	Juice extraction (%)		Juice pH		Brix		Sucrose (%)		Purity (%)	
	1993–94	1994–95	1993–94	1994–95	1993–94	1994–95	1993–94	1994–95	1993–94	1994–95
Variety										
'Co 1148'	56.2	57.1	5.3	5.2	19.2	19.5	16.1	16.1	83.9	82.5
'CoS 767'	55.3	55.4	5.2	5.4	18.5	19.3	15.8	15.5	85.4	80.2
'CoS 687'	57.1	57.9	5.3	5.3	19.1	19.4	17.1	17.0	89.5	87.5
'CoJ 64'	58.2	58.4	5.3	5.4	19.5	21.2	17.7	17.5	90.8	82.4
CD (P = 0.05)	2.2	2.9	NS	NS	0.6	0.7	0.7	0.8	3.6	3.7
Nitrogen (kg/ha)										
0	52.6	53.3	5.3	5.4	19.4	20.4	17.4	17.5	89.7	85.9
60	56.5	57.5	5.2	5.3	18.7	19.5	17.2	17.3	91.7	88.8
120	58.3	58.3	5.2	5.4	19.1	19.6	16.5	16.1	86.3	82.2
180	59.2	59.7	5.3	5.2	19.3	20.2	15.7	15.2	81.3	75.3
CD (P = 0.05)	2.9	2.9	NS	NS	0.6	0.7	0.7	0.7	3.6	3.7

Table 2. Reducing sugars, available sugars, number of millable canes, cane yield and commercial cane sugar yield as influenced by varieties of sugarcane and nitrogen application

Treatment	Reducing sugar (%)		Available sugars (%)		Millable canes ('000/ha)		Cane yield (tonnes/ha)		Commercial cane sugar yield (tonnes/ha)	
	1993–94	1994–95	1993–94	1994–95	1993–94	1994–95	1993–94	1994–95	1993–94	1994–95
Variety										
'Co 1148'	1.02	1.03	10.8	10.8	76.0	80.1	78.2	82.1	8.56	8.83
'CoS 767'	1.03	1.03	10.7	10.2	77.2	82.4	77.5	81.2	8.41	9.29
'CoS 687'	0.98	1.01	11.9	11.7	68.5	69.3	66.1	69.0	7.80	7.74
'CoJ 64'	0.93	0.92	12.4	11.7	64.6	70.2	62.5	67.8	7.81	7.93
CD (P = 0.05)	0.0002	0.0002	0.5	0.5	7.2	8.3	7.7	7.0	0.60	0.62
Nitrogen (kg/ha)										
0	0.78	0.80	12.1	11.9	62.7	66.5	51.3	51.9	6.60	6.19
60	0.95	1.01	12.1	12.0	69.8	76.0	66.6	70.0	8.01	8.39
120	1.05	1.08	11.3	10.7	76.4	79.0	83.0	88.6	9.30	9.51
180	1.18	1.12	10.4	9.6	77.5	80.4	83.6	89.6	8.63	8.64
CD (P = 0.05)	0.0002	0.0002	0.5	0.5	7.2	8.3	7.7	7.0	0.60	0.62

proteins, invertase activity might have been enhanced by increased nitrogen supply. Our results are in close conformity with those of Rana and Saini (1989).

Commercial cane sugar yield increased significantly with an increase in N level up to 120 kg/ha and thereafter declined by 8.2% with 180 kg N/ha. It might have been due to almost constancy in cane tonnage and remarkable deterioration in quality beyond 120 kg N/ha. Singh *et al.* (1998) were also of this view .

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