

Sugarcane Production and the Quality of Gur as influenced by Nitrogen

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ABSTRACT

An experiment was conducted to find the effect of nitrogen fertilizer on the yield of sugarcane and the quantity and quality of gur in the farmers fields at Ishurdi for consecutive two cropping season 1991-92 and 1992-93. Single eyed polyethylene bag settlings of variety Isd 16 were transplanted during November each year with four levels of nitrogen (0,80,120 and 160 kg N ha⁻¹) and three times of application (Basal+120 DAP+150DAP, Basal +120DAP and Basal +150 DAP). Significant difference in millable cane production and yield of cane was observed with varied level of nitrogen at different time of application. The highest yield of cane 108.0 and 63.0 TCH was found with 160 kg N ha⁻¹ level. Gur preparation in the later part of the season (February) produced significantly better quality with higher sucrose and minimum reducing sugar percent. Time of application of nitrogen had no significant effect on sucrose, reducing sugar, colour, pH and moisture content of gur in the first year but in he second year sucrose content and pH of gur was influenced due to time of nitrogen application. Nitrogen application at varied level did not show any significant positive effect on sucrose and reducing sugar content of gur in the first year but it significantly decreased the reducing sugar percent in the second year.

INTRODUCTION

Gur is the principal sweeteing item of the food for rural community of Bangladesh and is made extensitively from sugarcane. About 66% of the total sugar consumption is taken in the form of gur in this Indian subcontinent (Sheikh, 1986). The present production of about 0.5 million ton of gur in Bangladesh is produced from the entire sugarcane produced in the non-mill zones and a small portion from the mill zones. (Hossain, 1986). Of the total sugarcane acreage of the country, about 50% is covered in the non-mill zones area where farmers generally use a small quantity of fertilizers for sugarcane production. Sugarcane is a heavy feeder of plant nutrients, especailly N from the soil. Proper manuring is, therefore, an important aspect with reference to gur and white sugar manufacture. The quality of gur manufacture depends on several factors among them manuring is most important (Vaidyanathan *et al.* 1964). There is also a general belief that higher rates of nitrogen increase the cane yield, but the quality of cane juice and consequently the quality of gur produced are considerably affected. Nitrogen deficiency early in the growing season decrease cane yield while excess N at ripening stage reduces juice quality and sucrose content (Samuels, 1965). Standford and Ayres (1964) reported that sugarcane

required 1 kg of N for each metric ton of cane. Mutanda (1980) reported that high amounts of nitrogen fertilizer caused a reduction in the sucrose content of juice, while low application reduced cane yield. In spite of low recovery of applied nitrogen, sugarcane removes huge quantities of nitrogen from the soil. A 70 ton crop of sugarcane removes 108-130 kg N from soil (Yadav, 1981). Although a lot of information is available on nitrogen requirement of sugarcane for white sugar manufactured in Bangladesh (Rahman *et al.* 1989; Rahman *et al.* 1993; Majid *et al.* 1992; Alam and Majid, 1993) but information on the quality of gur is rather inadequate. Therefore, the present study was undertaken to find out the effect of rate and time of application of nitrogen on sugarcane production and on the quality of gur from sugarcane.

MATERIALS AND METHODS

A field experiment was carried out at farmers field of Ishurdi, High Ganges River Floodplain soils of Bangladesh in two consecutive cropping years of 1991-92 and 1992-93. The soils of the experimental site were low in total N (0.06%), organic matter content (0.7%), exchangeable K (0.09 meq/ 100 g soils), available P (13 ppm) and S (24 ppm). The experiment was laid in RCB design with four replications. The treatments consisted of all combinations of 3 time of nitrogen application (Basal +120DAP+150DAP, Basal+120 DAP and Basal + 150 DAP) and 4 levels of nitrogen (0, 80, 120 and 160 kg N/ha). Recommended rates of PKS and Zn were also used in the experiment at the rate of 100 kg P_2O_5 , 120 kg K_2O , 30 kg S and 10 kg Zn/ha. Half of N and K through urea and muriate of potash respectively along with full dose of P, S, and Zn were applied to sugarcane at the time of planting whereas the remaining N and K were top dressed as per schedule of the experiment. Forty five days old sugarcane seedlings of variety Isd 16 were used as test crop and were planted during November each year. Intercultural operations, pest and disease control measures were done as and when necessary. Data on tiller number, millable cane, yield of cane and recoverable sucrose content of cane were recorded. Physical and chemical properties of gur prepared from the sample were tested and recorded.

Gur was prepared from the cane of the experiment in three different times, October (early) December (mid) and February (late) on the following year. Juice quality was determined as per the method of Spencer and Meade (1955).

Soil texture was determined by hydrometer method, organic carbon was measured by wet oxidation method (Jackson, 1973). Soil pH was determined by taking soil and distilled water in 1:2.5 ratio with glass electrode pH meter (Hunter, 1980). Total N was determined by macro kjeldal method. Available P was determined by using 0.5M $NaHCO_3$ extraction in spectrophotometer (Black, 1975). Exchangeable K was measured by 1M NH_4OAc extraction in flame photometer and available S was determined by turbidimetric spectrophotometer method (Black, 1965).

RESULTS AND DISCUSSION

Yield and some parameters of sugarcane

The effects of time and levels of nitrogen on yield and yield parameters of sugarcane are presented in the Table 1. It is evident from the results that time of N application had no positive effect on tiller production of sugarcane. Millable cane production and yield of cane significantly increased on the following year but the effect was disappeared in the first year. Application of N at different time failed to bring any effect on recoverable sucrose content of sugarcane. While considering the levels of N in the first year there was a positive effect on tiller production though not in the following year. Millable cane production significantly increased with different levels of N application in 1992-93 and the maximum number of millable cane was found $95.2 \times 10^3/\text{ha}$ when N was applied at the rate of 160 kg/ha. Nitrogen application at varied level significantly increased cane yield in both the years. Maximum cane yield was recorded with the application of N at the rate of 160 kg/ha and it was 108 and 63.0 TCH respectively. Significantly yield increase due to different levels of nitrogen was reported by many investigators (Samuels, 1965, Thakur *et al.*, 1981). This results agree with findings of Majid *et al.*, (1992) who obtained significantly higher tiller, millable cane and yield of cane by application of 160 kg N/ha in the Ganges river floodplain soils. Alam and Majid (1993) reported that application of 160 kg N/ha produced significantly higher tiller, millable cane, yield of cane and sugar. Similar results was also obtained by Rahman and Chowdhury (1981) who suggested that optimum dose of nitrogen for sugarcane may be 170 kg/ha. It is also seen from the data that nitrogen application at varied level had no significant positive influence on recoverable sucrose content of sugarcane.

EFFECT ON GUR

Time of Gur production

Data on different physical and chemical properties of gur are presented in the Table 2. It is seen from the data that time of gur production significantly influenced the sucrose % reducing sugar %, pH and moisture content of gur due to different level and time of N application. In both the years it is seen that the sucrose content of gur significantly increased with gradual decrease in reducing sugar content of gur over time. The peak sucrose content of gur was found in February in the year whereas it was December on the following year. The reducing sugar content of gur was higher in October and it lowered down in February in both the year. Colour of gur was not influenced significantly in the first year but it was significant on the following year.

Table 1. yield and yield parameters of sugarcane as affected by different levels and time of nitrogen application.

Treatments	Tiller ($\times 10^3/\text{ha}$)		Millable cane($\times 10^3/\text{ha}$)		Yield of cane(TCH)		Recoverable Sucrose[%]	
	1991-92	1992-93	1991-92	1992-93	1991-92	1992-93	1991-92	1992-93
Time of application								
T ₁	149.8	160.1	115.6	89.4	101.8	48.5	8.57	9.00
T ₂	149.7	166.6	116.1	93.5	94.7	55.7	7.43	8.89
T ₃	119.5	159.2	115.9	85.1	100.6	53.4	7.82	9.01
CD(p=0.05) NS		NS	NS	4.833	NS	4.145	NS	NS
Level of nitrogen (kg/ha)								
0	142.0	147.8	112.5	78.7	82.4	43.5	8.02	8.85
80	153.4	169.7	117.6	91.9	102.5	49.7	8.05	9.02
120	150.6	165.7	115.7	91.6	103.3	53.9	7.95	9.10
160	152.8	164.7	117.5	95.2	108.0	63.0	7.98	8.90
CD(p=0.05)	8.184	NS	NS	5.581	11.37	4.786	NS	NS

*T₁=Basal+120DAP +150DAPT₂= Basal+ 120 DAPT₃=GBasal+ 150 DAP**Time of application**

It is seen from the Table 2 that the effects of time of nitrogen application on different parameters of gur was insignificant in the first year but had significant effect on sucrose content and pH of gur on the following year. The sucrose and reducing sugar content of gur was almost similar and statistically at par with different time of nitrogen application which clearly indicates that nitrogen application at different times had no effect on sucrose and reducing sugar content of gur. The maximum changes in sucrose content of gur, which is important from the grading point of view was ranged between 63.35 to 64.05% in the first year and 76.68 to 78.69% on the following year. This findings is in agreement with that of Gupta (1972) who described that the standard gur should not contain more than 70 to 75% sucrose, The percentage of reducing sugar ranged from 12.39 to 13.01% and 4.45 to 4.49% in the first and second year experiments respectively. The increase in reducing sugar in the first year experiment might be due to the hydrolysis of sucrose by the micro organisms responsible for deterioration of gur (Farooque, 1960). This is evident from the corresponding values of sucrose content of gur in the study. Greater the percentage of

reducing sugars, lower will be the quality and vice versa. Late application of nitrogen did not show any significant effect on moisture content of gur rather it lowered the moisture content and was 6.89 and 9.98% in the first and second year respectively. According to Farroque (1960), the optimum moisture level of gur is between 6 and 7%.

Table 2. Chemical properties of Gur as affected by different levels and time of Nitrogen application.

Treatment	1991-92					1992-93				
	Sucrose (%)	RS (%)	Colour (0.25N)	pH	Moisture (%)	Sucrose %	RS (%)	Colour (0.25N)	pH	Moisture (%)
Time of Gur Analysis										
October	57.16	16.96	69	5.26	9.37	77.10	5.06	76	5.46	8.32
December	64.74	13.00	67	5.18	6.21	78.85	4.20	67	5.60	11.87
February	69.54	8.39	68	5.27	6.72	77.46	4.15	65	5.33	10.68
CD(p=0.05)	2.066	0.957	NS	0.053	0.213	1.253	0.2528	7.1262	0.02664	0.7189
Time of N application*										
T ₁	64.02	12.94	69	5.24	7.38	76.68	4.49	69	5.52	10.71
T ₂	63.36	13.01	65	5.22	8.04	78.69	4.45	68	5.43	10.17
T ₃	64.05	12.39	66	5.25	6.89	78.03	4.47	70	5.45	9.98
CD(p=0.05)	NS	NS	NS	NS	NS	1.253	NS	NS	0.02664	NS
Time of Gur analysis										
October	57.16	16.96	69	5.26	9.37	77.10	5.06	76	5.46	8.32
December	64.74	13.00	67	5.18	6.21	78.85	4.20	67	5.60	11.87
February	69.54	8.39	68	5.27	6.72	77.46	4.15	65	5.33	10.68
CD(p=0.05)	1.809	0.74	NS	0.038	NS	NS	0.3076	5.839	0.04637	0.8680
Nitrogen level (kg/ha)										
0	64.83	12.57	72	5.29	7.39	77.28	4.70	68	5.46	10.63
80	63.50	12.84	67	5.21	8.11	78.06	4.53	72	5.47	10.04
120	62.67	13.08	63	5.23	6.78	77.78	4.49	69	5.46	9.91
160	64.26	12.64	70	5.22	7.46	78.09	4.16	67	5.47	10.57
CD(p=0.05)	NS	NS	5.825	NS	NS	NS	0.3552	NS	NS	NS

*T₁= Basal + 120 DAP+150 DAP

T₂= Basal+120 DAP

T₃=Basal + 150 DAP

Nitrogen level

Application of nitrogen at varied level did not show any significant positive effects on sucrose contents. pH and moisture content of gur. But the effect on reducing sugar was significant in the second year but not in the first year. From the results it is clear that nitrogen application at different dose had no effect on the quality of gur particularly on sucrose content, pH and moisture content which are the principal determinant of gur quality. The sucrose content of gur ranged from 62.67 to 64.83% in the first year and 77.28 to 78.09% in the second year which indicated that application of N had no effect in this aspect. Higher rates of nitrogen significantly lowered the reducing sugar content of gur in the second year and the minimum of 4.16% was recorded with 160 kg N/ha application. In the first year experiment, the reducing sugar content ranged between 12.57 to 13.08%. It is evident from the Table 2 that the higher rates of nitrogen gave comparatively lower colour reading (ranging between 71.83 to 63.00 and 71.78 to 66.94 kg/ha in the first and second year respectively) than control. Light coloured gur is generally preferred for table purposes. Gupta and Balyan (1973) stated that standard gur should not give higher colorimetric reading. Though the moisture content of gur is higher in the second year, the effect of nitrogen level on moisture content of gur was insignificant in both the year.

From the study it may be concluded that nitrogen application at varied rate in different times had not effect on the quality of gur rather it increased the production of sugarcane to a greater extent. However, further research works are needed for confirmations.

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