Effects of Nitrogen and Interplant Spacing on the Production of Seedcane and Germination of Buds

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ABSTRACT

An experiment was conducted during the 1992-93 and 1993-94 cropping seasons at Bangladesh Sugarcane Research Institute Farm, Ishurdi, Bangladesh with 4 levels of nitrogen viz. 0, 160, 220 and 280 kg/ha and 2 interplant spacing of 90 x 90 and 120 x 120 cm. The study was aimed to find the effects of nitrogen and interplant spacing on the yield and yield contributing parameters of seedcane as well as on the germination performance of sugarcane setts. In both the year, nitrogen application significantly increased the number of tillers, millable cane and yield of seed cane. Germination of sugarcane buds increased significantly with the nitrogen application. Maximum seedcane yield of 71.1 and 123.3 t/ha was found with the application of 220 kg N/ha at 90 x 90 cm interplant spacing in the first and second year respectively. Maximum mean germination of sugarcane buds 84.5% from top portion was obtained from the application of 280 kg N/ha at 90 x 90 cm plant spacing. Interplant spacing at varied level of N did not show any significant effect on germination % and recoverable sucrose content of seed cane. The overhall results suggest that application of 220 kg N/ha to sugarcane field to be grown for seed cane may be recommended for obtaining higher yield of seed cane and better germination of cane buds irrespective of interplant spacing.

Key words : Nitrogen, Interplant spacing, germination, cane buds.

INTRODUCTION

Sugarcane is vegetatively propagated crop. Conventionally the farmers use cut pieces of stem usually containing there buds for commercial cane cultivation. In Bangladesh farmers generally collect their seeds from the cane yield which is grown for milling, but not seed. The germination ability of this seed material is often low (30-40%). It has been observed that immature canes or immature top portions of cane stalks give higher sprout than mature bottom portions of cane stalks. The immature portion contains more reducing sugars with tender root primordia and the buds are not covered by dry scales. On the other hand, proper fertilization and good germination of sugarcane buds are important for higher yield of sugarcane. Among the various nutrients, nitrogen plays a vital role on the cane yield and subsequently germination of sugarcane buds. Nitrogen requirement of sugarcane varies from place to place according to soil, agro-climatic condition and other agronomic factors (Singh and Singh, 1972). Studies at home and abroad revealed that a significant positive relationship existed between the N dose and yield of cane (Rahman *et al.* 1989; Boramanikar and Borole, 1983; Majid *et al.* 1992; Banger and Sharma, 1991). Nitrogen deficiency in the early growing season decreases cane yield while excess N at rippening stage reduces juice quality and sucrose content (Samuels, 1965). Standford and Ayres (1964) reported that sugarcane required 1 kg nitrogen for each metric ton of millable cane production. Mutanda (1980) reported that application of higher amount of nitrogen fertilizer caused a reduction in the sucrose (%) of sugarcane juice while lower application reduced the cane yield. Poor yield of sugarcane is also reported elsewhere due to inadequate germination of sugarcane buds

leading to lower number of millable stalk and poor stalk weight (Khairwal and Babu, 1975; Matherne, 1975; Irvine *et al.* 1980). Considering the above facts, the present study has been carried out to find out the effects of nitrogen and interplant spacing on the production of seed and subsequently on the germination of sugarcane buds.

MATERIALS AND METHODS

The experiment was conducted during the 1992-93 and 1993-94 cropping seasons at the Bangladesh Sugarcane Research Institute farm. Four levels of nitrogen (0, 160, 220 and 280 kg N/ha) and two interplant spacings (90 x 90 and 120 x 120cm) were studied on the yield and yield contributing parameters of sugarcane as well as on the germinating ability of sugarcane buds. The sugarcane variety Isd 16 was used as test crop. Forty five days old sugarcane settlings raised in polythylene bags were transplanted in December each year and the cane of experiment was harvested in January at the age of 14 months. The crop received uniform dose of 110 kg P_2O_5 110 kg K_2O, 40 kg S and 10 kg Zn. Nitrogen was applied as per treatment. The experiment comprised of eight treatment combinations and were laid out in a randomized complete block design with three replication. Full doses of P, S and Zn 1/3 rd of K were applied in trenches before transplanting of sugarcane settlings. Nitrogen was applied in three equal installments. The first 1/3 rd N was applied in ring placement at 30d after transplanting. The rest of N and K were applied at 120 and 160 d after transplanting of sugarcane settlings. For determination of germination ability of the sugarcane buds, the cane of the experimental plots were harvested randomly during October in each year. Data on cane yield and yield contributing character for the first crop were recorded at scheduled time. The whole cane was divided into three portions viz., top, middle and bottom. Two eyed sets were prepared from each portion and the sets were planted in the field following randomized block design with four replications Germination of sugarcane buds were recorded at 45 d after plantation and the percent germination of sugarcane bud was calculated using the formula; % Germination = (No. of eye bud germinated ÷ No. of eye bud planted) x 100.

Soil samples prior to experimentation were collected and analyzed for some selected physical and chemical properties of the soil. The soils of the experimental sites were calcareous brown floodplain, sandy loam with neutral reaction (pH 7.2), low in organic carbon (0.44%), total N (0.051%) and available P (11.7 ppm), medium in available K (0.26 meq/100 g soil) and S (13.7 ppm). Standard procedures were followed for soil analysis (Jackson, 1973). Data on the first and second investigations were analyzed statistically following the standard test.

RESULTS AND DISCUSSION

Effects on yield and yield contributing parameters : Tillering of sugarcane was significantly influenced by the levels of nitrogen and interplant spacing. Tiller production significantly increased with increased rate of nitrogen (Table 1).The maximum number of tiller was produced in the treatment where nitrogen was applied @ 280 kg/ha in both the years. Results further showed that wider interplant spacing produced less tillers and closer spacing resulted in higher tillers. Mean data for tiller production showed that tiller production progressively increased with increased rate of nitrogen application and the mean maximum number of tillers 149.5×10^3 and 121.3×10^3 per hectare was obtained from the plot receiving N 280 kg/ha at 90 x 90 and 120 x 120 cm interplant spacing, respectively.

Table 1. Effects of nitrogen and inter-plant spacing on the tiller and millable cane production of seedcane.

N level (kg/ha)	Spacing (cm x cm)	Tiller (x10^3/ha)			Millable cane (x 10^3/ha)		
		1992-93	1993-94	Pooled	1993-94	1994-95	Pooled
0	90 x 90	102.4b*	121.0b	112.1	40.3b	52.1e	46.2
	120 x 120	83.1c	105.5c	94.3	40.7b	59.0d	49.9
160	90 x 90	121.8ab	149.8a	135.8	92.1a	123.5a	107.8
	120 x120	105.8ab	127.3b	116.4	79.0a	92.6c	85.8
220	90 x 90	140.6ab	143.1a	141.9	90.1a	110.9b	100.5
	120 x 120	115.1ab	118.9b	117.0	93.5a	98.8c	96.2
280	90 x 90	148.9a	150.1a	149.5	91.9a	114.2ab	103.1
	120 x 120	115..8ab	126.7b	121.3	79.3a	95.8c	87.6

* Figures accompanied by similar letter(s) in a column do not differ significantly at 5% level of probability as per DNMR test.

This result are in agreement with the findings of Rahman *et al.* (1987), Uddin *et al.* (1989), Majid *et al.* (1992) and they obtained maximum number of tillers with high rates of nitrogen at closer spacing. Millable cane production was found to be significantly influence by the rates of nitrogen irrespective of interplant spacing. The maximum number of millable cane (93.5 x 10^3 /ha) was found ate 120 x 120 cm interplant spacing with the application of 220 kg N/ha in the first year which was again statistically at par with 160 and 280 kg N/ha application irrespective of interplant spacing. In the second year, 160 kg N/ha application at closer spacing produced significantly the highest number of millable cane (123.5 x 10^3 /ha). This results also agree with the findings of Majid *et al.* (1992). Mean data on millable cane also showed that closer interplant spacing produced higher millable cane than wider spacing irrespective of N level. The maximum number of millable cane 107.8 x 10^3 /ha was found from the plot where the crop received 160 kg N/ha at 90 x 90 cm interplant spacing. The differences in yield due to different interplant spacing and various levels of nitrogen were found to be significant (Table 2).

Table 2. Effects of nitrogen and inter-plant spacing on the yield (TCH) and recoverable sucrose content (%) of seedcane.

N level (kg/ha)	Spacing (cm x cm)	Yield of cane (TCH)			Recoverable sucrose content (%)		
		1992-93	1993-94	Pooled	1993-93	1994-94	Pooled
N_0	90 x 90	28.8d*	33.3e	27.6	10.01a	10.62a	10.32
	120 x 120	22.1d	38.0d	30.1	10.03a	11.04a	10.54
N_{160}	90 x 90	73.3a	105.1bc	89.2	10.62a	9.24a	9.93
	120 x120	57.9bc	96.9c	77.4	11.04a	9.44a	10.24
N_{220}	90 x 90	71.1a	123.3a	99.7	10.22a	9.24a	9.73
	120 x 120	67.0abc	113.6bc	90.3	10.09a	9.27a	9.68
N_{280}	90 x 90	70.4ab	95.6ab	83.0	9.84a	9.30a	9.57
	120 x 120	56.1c	94.5c	75.0	9.70a	9.23a	9.45

* Figures accompanied by similar letter (s) in a column do not differ significantly at 5% level of probability as per DNMR test.

Significantly, the highest cane yield (73.3 t/ha) was found at N 160 kg/ha in the first year, compared to the other nitrogen levels. This cane yield was statistically at par with that of 220 kg N/ha. But in the second year maximum cane yield (123.3 t/ha) was found at 220 kg N/ha. It is also seen from the results that yield of cane was positively influenced by the increasing level of nitrogen but upto 220 kg N/ha in both the years and there after it declained as the rate increased upto 280 kg N/ha. Rahman and Khalequzzaman (1981) and Majid *et al.* (1992) reported that the increased level of nitrogen upto 200 kg/ha increased sugarcane yield but decreased beyond that level. Boramaikar and Borole (1983) recommended 250 kg N/ha for sugarcane production in India. It is also seen from the data that closer interplant spacing (90x90 cm) significantly produced maximum cane yield in both the years at same level of nitrogen application. The highest mean yield (99.7 t/ha) was obtained with the application of 220 kg N/ha at 90 x 90 cm interplant spacing. Mean data also indicated that the cane yield increased with increased rate of N application upto 220 kg N/ha irrespective of interplant spacing and there after it declined as the rate increased. Closer interplant spacing gave maximum cane yield at same level of nitrogen application over wider interplant spacing. This might be due to the higher number of millable cane stalks produced in closer interplant spacing. Matherne (1974) reported that the yield of sugarcane is positively correlated with the final stalk population in the field. Application of nitrogen at varied levels in different interplant spacing did not show any significant effect on recoverable sucrose content of sugarcane. It is seen from the pooled data that the sucrose content of sugarcane is less with the higher amount of nitrogen application. The maximum sucrose content of 10.54% was found with the control treatment and the minimum (9.45%) was recorded at 280 kg N/ha. This results clearly indicates that nitrogen application at higher level reduces the juice quality by increasing the reducing sugar content in juice.

Effects on bud germination : Data on germination of sugarcane buds of different portions of seed cane are presented in the Table 3.

Table 3. Effects of nitrogen and spacing on the bud germination (%) of different portions of sugarcane setts.

N level	Spacing	Top portion			Middle portion			Bottom portion		
(kg/ha)	(cm xcm)	1992-93	1993-94	Pooled	1992-93	1993-94	Pooled	1992-93	1993-94	Pooled
No	90 x 90	46 c*	51 d	48.5	40 c	28 f	34.0	38 e	28 f	33.0
	120 x 120	48 c	55 d	51.5	42 c	36 e	39.0	31 e	36 e	33.5
N 160	90 x 90	68 b	62 c	65.0	61 b	38 cde	49.5	50 b	38 cde	44.0
	120x120	72 b	68 bc	70.0	61 b	37 de	49.0	45 b	37 de	41.0
N 220	90 x 90	76 b	73 ab	74.5	72 ab	48 a	60.0	50 b	48 a	49.0
	120 x 120	74 b	78 a	76.0	67 ab	42 bcd	54.5	44 b	42 bcd	43.0
N 280	90 x 90	88 a	81 a	84.5	65 ab	42 bcd	53.5	61 a	42 bcd	51.5
	120 x 120	89 a	78 a	83.5	83 a	44 ab	63.5	67 a	44 ab	55.5

* Figures accompanied by similar letter (s) in a column do not differ significantly at 5% level of probability as per DNMR test.

It is seen from the data that germination of sugarcane buds was significantly influenced by nitrogen application. Increased rate of nitrogen significantly increased germination irrespective of seed portion. The maximum germination of cane bud (89%) was obtained from the top portion of sugarcane raised sets at 280 kg N/ha level. The higher level of nitrogen application failed to increase the germination of buds of middle and bottom portions compared to the top portions. It is also seen from the table that germination of cane bud was positively influenced by increasing level of nitrogen in both the years irrespective of seed cane portion. Top portion of seedcane gave the maximum germination of bud. But the minimum germination 89% was found where higher N (280 kg/ha) was applied to the crop. Partharasrathy (1972) reported that the immature canes or immature top portions of seed-cane gave better sprout than mature bottom portions. In middle portions of seed-cane the minimum germination (40%) was found in control and the percentage germination of cane bud increased with increasing level of nitrogen and attain the peak (83%) with nitrogen applied @ 280 kg/ha to the crop. similarly the germination of bottom portion was only 28% which increased with higher rates of nitrogen and maximum of 67% was recorded in treatment where nitrogen was applied @ 280 kg/ha. Mean data on germination percentage indicated that nitrogen application progressively increased the bud germination in all portions of seed-cane. The minimum germination was recorded in control while the maximum was found with the highest rate of nitrogen application. From the data it is also seen that interplant spacing had no effect on percentage germination of cane bud in any portions of seed-cane. However, at lower rates (160 and 220 kg N/ha) germination of bottom cane bud was slightly better in closer spacing but in the top portion it was reverse.

The overall result suggest that application of N @ 220 kg/ha to sugarcane field raised for seedcane may be a good practice for obtaining higher yield of seedcane irrespective of interplant spacing and better germination of cane buds.

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