Bangladesh J. Sugarcane, 16 : 105-111 July, 1994

Interactions of Nitrogen and Interplant Spacing on Sugarcane yield under Irrigated Condition

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Received on 22.1.94

ABSTRACT

An experiment was conducted during 1990-92 with three interplant spacings and three nitrogen doses to determine the suitable combination under irrigated condition for sugarcane yield. The experiment was laid out in split-plot design taking nitrogen levels as main plot and interplant spacings as subplot treatments. Significant differences were observed among the interplant spacing, nitrogen doses and their interactions. The highest tillers and millable cane were obtained at 60 cm interplant spacing where @ 200 kg N ha-1 was applied. The highest sugarcane yield was obtained in 60 cm spacing, while in case of nitrogen doses, the highest yield of sugarcane was obtained at 200 kg N ha^{-1}. Among the interactions, the highest sugarcane yield was recorded at 60 cm interplant spacing with @ 200 kg N ha^{-1}. Maximum economic benefit (Tk. 59.6 X 10^3 ha^{-1}) was also gained with the same treatment combination.

INTRODUCTION

In Bangladesh, average sugarcane yield is low due to various reasons including management problems. Among them fertilization, irrigation and plant spacings are important agronomic practices which have 12-49% contribution in sugarcane production (Ali, *et al.*, 1989). Nitrogen is considered as an essential input for successful sugarcane production (Thomas, 1978; James, 1983). The recommended dose of nitrogenous fertilizer for sugarcane is 125 kg N ha^{-1} (Ali, 1974). But higher millable cane and yield may be obtained through cultivation of modern sugarcane varieties following spaced transplanted technology by adjusting interplant spacing and levels of nitrogen under irrigated condition. Higher yield was obtained at 0.9 m to 1.0 m inter row and 60 cm interplant spacing with higher doses of nitrogen (above 120 kg N ha^{-1}) application (Anon. 1981a; Matharne, 1974. Majid *et al.* 1992). Earlier works on planting techniques, tillering and sugar productivity by Rahman *et al.* (1987). Rahman and Matin (1988) and Narasiman *et al.* (1981) indicated that interplant spacing for transplanted sugarcane need not be any lesser than 60 cm for both Autumn and Summer transplanting. Several other studies also revealed a significant response of higher dose of nitrogen (200-250 kg N ha^{-1}) in producing the highest yield of sugarcane (Rahman and Khalequzzaman, 1981; Boramanikar and Borole, 1983; Anon., 1981b). Recently Banger and Sharma (1991) reported that the

highest doses of N (450 kg N ha^{-1}) gave the highest sugarcane yield at the level of adequate soil moisture. Srivastava et al, (1988) found that higher rate of nitrogen application in early planted sugarcane produced higher cane yield at higher spacing. Spaced transplanting of sugarcane is a new technique. In this method higher and uniform cane stand can be maintained (Rahman, 1979; Srivastava *et al.* 1985; Tang and Chen, 1974) which ultimately leads to higher millable cane formation and yield.

In South Western part of Bangladesh the water holding capacity of soil is poor and due to early soil moisture depletion the autumn plantation is encouraged. Therefore, the experiment was conducted to determine optimum doses of nitrogen and interplant spacing of autumn transplanted sugarcane for obtaining higher yield under irrigated condition.

MATERIALS AND METHODS

The experiment was conducted during 1990-92 at Chuadanga District of South Western part of Bangladesh. The trial was laid out in Split-plot design with 3 replications and the unit plot size was 8m x 10m. Three interplant spacing such as 45 cm, 60 cm and 75 cm were taken as main-plot treatment and three doses of nitrogen such as 120,160 200 kg N ha^{-1} as sub-plot treatments. There were 9 treatment combinations. The source of nitrogen was urea having 46% nitrogen. In all the treatments recommended doses of 165 kg K_2O, 133 kg TSP, 33 kg S, 14 kg Zn, 10 ton cowdung and 0.5 ton oil cake per hectare were applied. Full doses of TSP, Zypsum, $ZnSO_4$, cowdung, oil cake and one-third of MP were applied in pit at the time of transplanting.

Urea was applied in three equal splits. The first one third N as Urea was applied in ring placement as first top dressing within 15-30 d after transplanting. The 2nd one third of N and MP were applied as 2nd top dressing within 90-120 d after transplanting and the rest part of N and MP were applied as 3rd top dressing within 140-160 d after transplanting of sugarcane settlings. Single flood irrigation of 60 mm depth were applied for the establishment of sugarcane settlings within 24 h of transplanting. Five number of irrigations were applied at tillering stages to depth around 70, 85, 100, 120 and 140 mm within 25-30, 60-65. 80-90, 120-130 and 150-155 d after transplanting. Furrow method of irrigation was used for applying flood irrigation to the experimental plots (Michael, 1987).

The soils of the experimental site was calcareous brown flood plain and belongs to High Ganges River Floodplain. The properties of soils are presented in the Table 1. Prior to fertilizer application, the soil samples from different horizons were collected, processed and analyzed for pH and total available nitrogen. The pH was determined with a digital pH meter in 1N KCl, while total nitrogen was determined by standard macro-Kjeldahl method (Black, 1965). The soil textural classification was determined by hydrometer method. Bulk density by core sampler method. Field capacity by gravimetric method. Intercultural operations were done as and when required.

Data on tiller production, millable cane formation and cane yield were recorded and analysed.

RESULTS AND DISCUSSION

Tillering of sugarcane was strongly influenced by interplant spacing and nitrogen levels and the number of tiller production was increased with the increased level of nitrogen up to 160 kg N ha^{-1},and beyond that tiller production gradually decreased. It is seen from the Figure 1 that the increasing nitrogen level and interplant spacing beyond 160 kg N ha^{-1}, and 60 cm respectively decreased the tiller production. It is evident that under all the three levels of nitrogen, 60 cm interplant spacing receiving 160 kg N ha^{-1} produced the highest number of tillers. Similarly among three spacing 60 cm was found to be superior to 45 cm and 75 cm interplant spacing. Similar results were reported elsewhere (Mazid *et at.* 1992; Narsiman *et al.* 1991; Rahman *et al.* 1988). Millable cane production was found to be positively influenced by increasing of nitrogen level irrespective of spacing. Further, the number of millable cane per hectare gardually declined beyond 60 cm spacing under all levels of nitrogen application (Figure 2). Similar findings were observed earlier by Rahman and Khalequzzaman (1981) and Anon. (1981a).

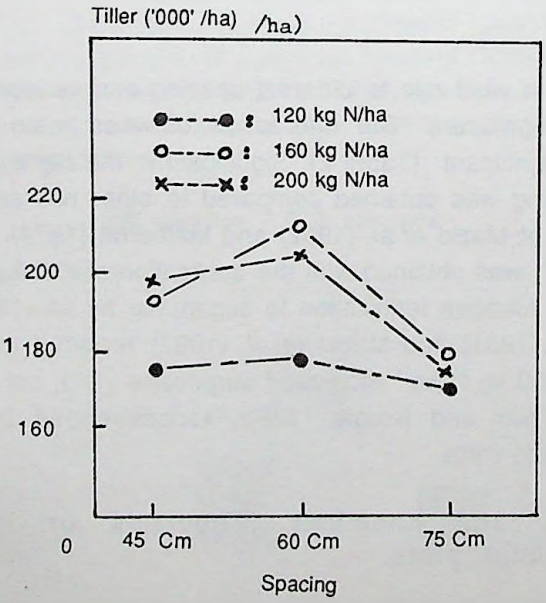

Figure 1. Effects of different levels of nitrogen and interplant spacing on tillering.

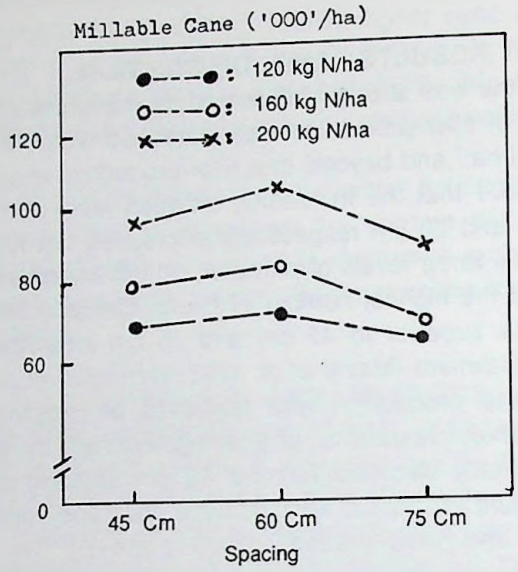

Figure 2. Effects of different levels of nitrogen and interplant spacing on millable cane production.

The differences in yield due to different spacing and various levels of nitrogen were found to be significant. The interaction between main plot and sub-plot treatments was insignificant (Table 2). Significantly the highest yield (118.3 tons ha^{-1}) at 60 cm spacing was obtained compared to other two spacings. The result confirms the findings of Mazid *et al.* (1992) and Matherne (1974). The highest mean yield (132.7 tons ha^{-1}) was obtained with the application of 200 kg N ha^{-1}. The initial recommendation for nitrogen fertilization to sugarcane by Ali (1974) was 125 kg N ha^{-1}. Rahman *et al.* (1981) and Mazid *et al.* (1992) reported that the increase of nitrogen level up to 200 kg N ha^{-1} increased sugarcane yield, but decreased beyond that level. Boramanikar and Borole (1983) recommended 250 kg N ha^{-1} for sugarcane production in India.

Table 1. Physical and chemical properties of initial soils of experimental plots.

Soil texture	Field capacity (%)	Bulk density (g/cc)	pH	% N	Soil type
Sandy loam	27.5	1.33	7.5	0.072	Calcareous brown floodplain

Table 2. Yield of sugarcane and recoverable sucrose content (%) under different levels of nitrogen and interplant spacings.

Main plot treatments (interplant spacings, cm)	Sub plot treatments (N kg ha-1)			Mean
	N_{120}	N_{160}	N_{200}	
45	86.5 c*	103.2 b	123.4 a	104.1 b
	(8.6)**	(8.4)	(8.8)	(8.6)
60	89.1 c	116.4 b	149.5 a	118.3 a
	(8.8)	(8.5)	(8.7)	(8.6)
75	88.3 c	106. 8 b	125.1 a	106.7 b
	(8.4)	(8.5)	(8.8)	(8.5)
Mean	87.6 c	108.8 b	132.67 a	
	(8.6)	(8.5)	(8.7)	

* Figures in the same column/row accompained by the same letters are not significantly different at 5% level of significance.

** Figures in parenthesis represents the percent recoverable sucrose content.

LSD (5%) =13.6 for N at same level of S., LSD (5%) =13.8 for S at same of different levels of N

LSD (5%) = 8.4 for spacing (S), LSD (5%) = 7.85 for nitrogen (N).

The highest yield (149.5 tones ha^{-1}) was obtained in interplant spacing of 60 cm along with 200 kg N ha^{-1}. Sugarcane yield was significantly increased as the levels of nitrogen was increased irrespective of interplant spacing (Table 2). Similar results were reported elsewhere (Banger and Sharma, 1991; Srivastava *et al.* 1991. In case of spaced transplanted sugarcane, Rahman *et at.* (1989) suggested 60 cm interplant spacing for autumn transplanting.

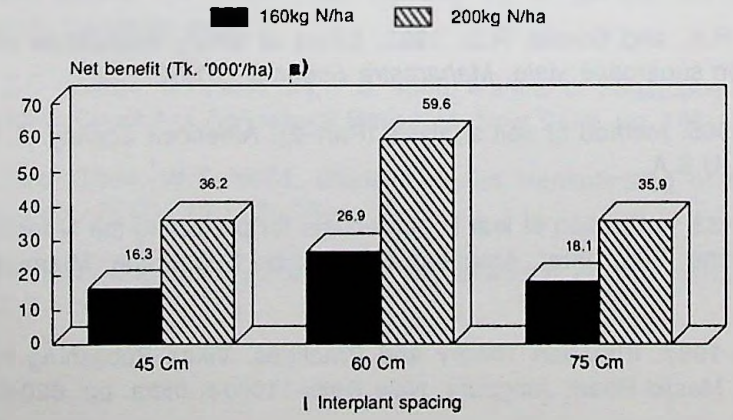

Figure 3. Net benefit of sugarcane over recommended nitrogen dose (120 kg N/ha).

The economic analysis of sugarcane yield was done, and is shown in the Figure 3. The highest economic benefit (Tk. 59.6 $X10^3$ ha^{-1}) was obtained from the treatment of 60 cm interplant spacing receiving @ 200 kg N ha^{-1} over 120 kg previous recommended nitrogen dose ha^{-1}. Therefore, it may be concluded that for obtaining higher yield of sugarcane, an interplant spacing of 60 cm with application of 200 kg N ha^{-1} would be practiced for autumn transplanted sugarcane under irrigated condition.

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