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Effect of Nitrogen, Phosphorus and Potassium on Some Advanced Promising Clones / Varieties of Sugarcane at High Ganges River Floodplain

K. M. Alam, M. A. Haque, S. M. Bokhtiar and G. C. Paul
Bangladesh Sugarcane Research Institute,
Ishurdi, Pabna, Bangladesh.

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ABSTRACT

The field experiments were conducted to evaluate the effects of varying levels of N (0, 100, 150, 200 kg N ha^{-1}), P (0, 30, 50, 70 P ha^{-1}) and K (0, 60, 90, 120 Kg ha^{-1}) on four promising clones (I 202-97, I 110-98, I 131-97 and I 98-98) and one standard variety Isd 34 at Bangladesh Sugarcane Research Institute farm soils under High Ganges River Floodplain (AEZ 11). Results revealed that sugarcane clones and NPK significantly differed with yield attributes, yield and brix per cent but N& K interaction effect was not significantly influenced. The interaction effects of P was significantly influenced with yield attributes and yield of sugarcane. Individually N increased cane yields to the extent of 69.49% with the application of 200 kg N ha^{-1}. In respective of yield potentiality, the studied clones followed the order: I 202-98>I 131-97>I 110-97>I 98-98. But I 202-98 and I 131-97 showed superiority in recovery per cent compared to the rest. It was found that the clone I 202-98 with 150 kg N, 50 kg P and 60 kg K ha^{-1} proved its superiority because of its inherent potentiality and better adaptability in High Ganges River Floodplain soils.

Key words: Sugarcane, nitrogen, phosphorus, potassium and clone

INTRODUCTION

Sugarcane is a long duration crop. It requires high amount of nutrients for its growth and development. As our land resources are limited, the increased target of production has to be mostly achieved by raising the productivity of cane per hectare and improving its quality. Clones for sugarcane production should contain high sucrose with less amounts of non-sugars and should have capacity to withstand adverse environments. Sugarcane varieties differ in nutrient requirement from place to place according to soil and agro-climatic conditions (Davidson, 1962; Raghaviah and Singh, 1980; Trivedi and Saini, 1986). Some varieties have ability to absorb and utilize more nutrients from a soil under the same climatic condition and produce more cane and sugar (Humbert, 1968). The application of balanced dose of NPK produced the maximum cane yield. Increased yield of sugarcane was obtained from application of N, P, K to most soils (Tabayoyong and Robeniol, 1962). The application of NPK beyond 100 per cent of the recommended dose had produced only marginal increase in cane and sugar yield (Alexander *et al.*, 2003). Yield potentiality of a crop would not reach a maximum unless proper fertilizer management is made. Sugarcane variety shows a tendency to decline in yield and vigor which needs replacement of the existing varieties with the new one (s). Thus, It is necessary to determine the optimum dose of N, P and K of four advanced promising clones for their maximum yield.

MATERIALS AND METHODS

Three separate experiments were conducted under study at the Bangladesh Sugarcane Research Institute experimental farm located in Ishurdi series under High Ganges River Floodplain soils (AEZ 11) of Bangladesh (Typic-Eutrocrept) during 2004-2005 cropping season. The soil of the experimental site is sandy loam with medium high land having pH 7.6 to 7.8, low in total N 0.034 per cent, available P 6.00 ppm, K 0.16 meq % and S 17.70 ppm. The climate of this location is sub-tropical. Forty-five days old one budded soil bed settling of the studied clones/variety (I 131-97, I 202-97, I 98-98, I 110-98 and one standard variety Isd 34) were used as test materials and transplanted in November and harvested at the age of 13 month. The experiments were laid out in split plot design with three replications. Two factors mainly clones/variety and nutrient was involved in the experiment. The unit plot size was 5m × 4m in the experiments having row to row and plant to plant distance of 100 cm and 50 cm, respectively. The recommended management practices were done when required.

In the first experiment, four levels of nitrogen (0, 100, 150 & 200 kg ha^{-1}) as urea were applied in three splits: first at the settling establishment stage (25 days), second at the tiller initiation stage (90 days) and third at the grand growth phase (180 days). Full amount of triple super phosphate, one third of muriate of potash, full doses of gypsum and zinc sulphate were applied in the cane furrows and mixed thoroughly with soils to supply P, K, S and Zn at the rate of 52, 90, 34 and 3.2 kg ha^{-1}. Remaining two third of muriate of potash were applied in two splits as top dressed after 90 and 180 days of settling plantation.

The second experiment comprised of four phosphorus levels (0, 30, 50 and 70 kg ha^{-1}) from triple super phosphate and were applied in the trenches and mixed with soil at the time of plantation. Nitrogen were added at the rate of 150 kg ha^{-1} in three installments as before where as K, S and Zn were applied at the same rates as was done in the first experiment. In this experiment four clones viz. I 131-97, I 202-97, I 98-98, I 110-98 and one standard variety Isd 34 were used.

The third experiment included four level of potassium (0, 60, 90, 120 kg ha^{-1}) as murate of potash. Potassium fertilizer was applied in three installments as stated in the first experiment. The other fertilizers were applied at the rate of 150 kg N, 52 kg P, 34 kg S and 3.2 kg Zn ha^{-1} in the plots in the same sequence like other two experiments. Data were subjected to statistical analysis and the significance of mean difference was calculated following least significance difference test (LSD) at 5% level.

RESULTS AND DISCUSSION

Yield and yield attributes:

The most important yield determinant tiller, millable cane stalks, quality parameter as indicated brix per cent and yields of sugarcane were studied. Results have been presented in Table 1, 2 and 3. Results revealed that nitrogen fertilization had a highly significant effect on yield and its component of sugarcane. Appreciable increase in almost all the attributes was observed with increasing rate of fertilizer (Table 1). Tiller, millable cane stalk and cane yield was increased significantly with every increment in nitrogen application. Application of 200 kg N ha^{-1} produced the highest sugarcane yield (67.00 t ha^{-1}) which was superior to the rest of the N doses (Fig.1). Increasing in cane yield was 46%, 58% and 69% due to 100, 150 and 200 kg N ha^{-1}, respectively over control. Although the per cent brix did not differ significantly but the higher brix percentage was found without N fertilization. Tiller and millable cane stalk were differed significantly with the application of N fertilizer. The highest number of tiller (119.23 x 10^3 ha^{-1}) and millable cane (83.45 x10^3 ha^{-1}) were found at the rate of 200 kg N ha-1. Among the varieties, the tiller, millable cane stalk, yield and brix per cent were also differed significantly. The highest number of tiller was found Isd 34 (114.58 x 10^3 ha^{-1}), which was followed by the clone I 202-97 (109.63 x 10^3 ha^{-1}). The highest millable cane stalk was recorded in Isd 34 (79.03 x 10^3 ha^{-1}) but it was statistically identical with I 202-97 (76.73 x 10^3 ha^{-1}). The highest and lowest yield was found in I 202-97 (67.00 t ha^{-1}) and I 98-98 (48.04 t ha^{-1}), respectively. The variety Isd 34 and clone I 131-97 produced the identical yield. Golden (1983) observed that nitrogen concentration in the above and below ground parts of the sugarcane increased as the nitrogen applications increased. The highest brix per cent was found in I 202-97 (20.58 %) which was statistically identical to I 131-97 (20.43%). Among the clones, the lowest brix per cent was found Isd 34 (19.23%) which was identical to the clone I 110-98 (19.57%). There was no significant interaction of nitrogen and clones/ variety on these parameters.

In P experiment, the tiller, millable cane stalk, yield and brix percentage did not show any significant effect with every increased of 20 kg P ha^{-1} (Table 2). But among the clones/variety, the P application had significant effect on yield and yield contributing characters. The variety Isd 34 recorded the highest number of tiller (151.29 x 103 ha^{-1}). The second highest number of tiller was found in I 98-98 (133.81 x 10^3 ha^{-1}) but it was statistically similar to I 202-98 (128.71 x 103 ha^{-1}). The lowest tiller was recorded in I 110-97 (111.77 x 10^3 ha^{-1}). The interaction effect between phosphorus and variety was statistically significant in respect of tiller production. The clones I 202-98, I 110-97 and I 131-97 were more responsive to P fertilization. The highest millable cane stalk was recorded in Isd 34 (101.17 x 103 ha^{-1}). The second highest millable cane stalk was found in I 202-98 (91.08 x 103 ha^{-1}) which was identical to the clone I 98-98 (90.72 x 10^3 ha^{-1}). The lowest millable cane stalk was found the in I 110-97 (78.25 ´ 103 ha-1) that was statistically similar to I 131-97 (79.70 x 10^3 ha^{-1}). The interaction effect between phosphorus and variety was statistically significant in respect of millable cane stalk production. The clones I 202-98, I 110-97 and I 131-97 were found more responsive to P fertilization. The cane yield was differed significantly among the

clones/variety. The clone I 202-98 recorded highest yields (75.43 t ha^{-1}). The second highest yield was obtained in lsd 34 (67.83 t ha^{-1}). The clones I 110-97 (61.46 t ha^{-1}), I 131-97 (61.80 t ha^{-1}) and I 98-98 (61.93 t ha^{-1}) were found as statistically similar in producing yield. The interaction effect between phosphorus and clones/variety was statistically significant in respect of yield. Application of phosphorus increased the yield of all clones/variety except I 98-98. Morris et al., (2002) reported that P was an essential plant nutrient that contributed to optimum sugarcane yields. The brix per cent of the clone/variety was statistically significant. The clone I 131-97 recorded the highest brix per cent (20.70%) which was statistically similar to I 202-98 (20.28%). The second highest brix was I 202-98 (20.28%) which was statistically identical to I 110-97 (19.66%) and I 98-98 (19.63%). The lowest brix per cent was found lsd 34 (18.85%). The interaction effect between phosphorus and clones/variety was not significant in respect of brix per cent.

In K experiment, the production of tiller and millable cane stalk was differed significantly with the application of potassium fertilizer (Table 3). The highest number of tiller (145.53 x 10^3 ha^{-1}) was found with the application of 90 kg K ha^{-1} that was statistically identical to the rates of K at 60 and 120 kg K ha^{-1}. The highest millable cane stalk (99.71 x 10^3 ha^{-1}) was found with the application of 60 kg K ha^{-1} that was statistically identical to the rates of K at 90 and 120 kg K ha^{-1}. The yield and brix per cent did not differed significantly with the application of potassium fertilizer. Among the clones/variety the K application had the significant effect on tiller, millable cane stalk and brix per cent. The variety lsd 34 recorded the highest number of tiller (157.83 x 103 ha^{-1}) which was statistically identical to I 202-98 (149.71 x 103 ha^{-1}). The second highest number of tiller was recorded in I 202-98 (149.71 x 10^3 ha^{-1}) that was followed by the clone I 98-98 (137.50 x 10^3 ha^{-1}). The lowest number of tiller was recorded in I 110-97 (123.75 x 10^3 ha^{-1}). The variety lsd 34 recorded the highest millable cane stalk (109.90 x 10^3 ha^{-1}), which was identical to I 202-98 (104.77 x 10^3 ha^{-1}). The clone I 98-98 (93.36 x 10^3 ha^{-1}), I 131-97 (89.77 x 10^3 ha^{-1}) and I 110-97 (86.35 x 10^3 ha^{-1}) produced similar production of millable cane stalk. The yield and brix per cent of the clones/variety did not differ significantly with the application of potassium fertilizer. There was no significant interaction effect of potassium and clones/variety on these parameters.

Thus, the findings suggested that the clone I 202-98 with 150 kg N, 50 kg P and 60 kg K ha-1 proved its superiority because of its inherent potentiality and better adaptability to the climatic condition.

Table 1: Effects of Nitrogen, Variety and Nitrogen x Variety interaction on yield and yield con tributing parameters of some clones /variety of sugarcane, BSRI, Ishurdi, 2004-05

Variable	Tiller (×10^3 ha^{-1})	Millable cane (×10^3 ha^{-1})	Yield (t ha^{-1})	Brix (%)
Nitrogen level (kg/ha)				
0 (N_0)	69.50 b	48.55 b	39.53 c	20.04
100 (N_1)	105.10 a	73.52 a	57.87 b	19.77
150 (N_2)	111.83 a	77.62 a	62.57 ab	19.59
200 (N_3)	119.23 a	83.45 a	67.00 a	19.89
S.E. (±)	6.02	4.43	2.15	NS
Variety				
lsd 34 (V_1)	114.58 a	79.03 a	58.88 b	19.23 d
I 202/98 (V_2)	109.63 a	76.73 ab	67.00 a	20.58 a
I 110/97 (V_3)	88.21 c	61.75 d	52.83 cd	19.57 cd
I 131/97 (V_4)	95.04 bc	66.56 cd	56.95 bc	20.43 ab
I 98/98 (V_5)	99.63 b	69.85 bc	48.04 d	19.96 bc
S.E. (±)	3.40	2.46	1.77	0.19
Nitrogen × variety				
V_1N_0	73.17	50.01	38.17	19.20
V_1N_1	76.50	53.55	48.00	21.27
V_1N_2	57.50	40.25	38.33	18.83
V_1N_3	76.50	53.55	44.67	20.50
V_2N_0	63.83	45.38	28.50	20.47
V_2N_1	126.50	88.55	63.33	19.37
V_2N_2	113.67	79.57	68.17	20.30
V_2N_3	95.50	66.85	56.33	19.37
V_3N_0	98.67	69.07	52.17	19.87
V_3N_1	91.17	63.55	49.33	19.03
V_3N_2	126.17	84.98	69.67	19.10
V_3N_3	119.50	83.65	72.00	20.23
V_4N_0	95.00	66.50	55.50	20.60
V_4N_1	97.17	68.02	63.50	21.07
V_4N_2	121.33	84.93	52.17	20.60

In a column, the figures having same letter do not differ significantly as per LSD at 5% level.

Table 2: Effects of Phosphorus, Variety and Phosphorus ´ Variety interaction on yield and yield contributing parameters of some clones /variety of sugarcane, BSRI, Ishurdi, 2004-05

Variable	Tiller ($\times 10^3$ ha^{-1})	Millable cane ($\times 10^3$ ha^{-1})	Yield (t ha^{-1})	Brix (%)
Phosphorus level (kg/ha)				
0 (P_0)	123.78	86.72	62.83	20.04
30 (P_1)	132.33	87.51	64.45	19.77
50 (P_2)	124.75	87.63	65.67	19.59
70 (P_3)	129.83	90.87	67.35	19.89
S.E. (±)	NS	NS	NS	NS
Variety				
Isd 34 (V_1)	151.29 a	101.17 a	67.83 b	18.85 c
I 202/98 (V_2)	128.71 b	91.08 b	75.43 a	20.28 ab
I 110/97 (V_3)	111.77 c	78.25 c	61.46 c	19.66 b
I 131/97 (V_4)	112.79 c	79.70 c	61.80 c	20.70 a
I 98/98 (V_5)	133.81 b	90.72 b	61.93 c	19.63 b
S.E. (±)	2.86	1.87	1.79	0.24
Phosphorus × Variety				
V_1P_0	145.00 a	96.93 a	63.50 b	19.27
V_1P_1	135.00 a	94.50 a	74.57 a	20.87
V_1P_2	107.75 b	78.05 b	62.00 b	19.77
V_1P_3	113.00 b	82.13 b	65.60 ab	20.80
V_2P_0	118.17 b	82.72 b	60.83 b	19.50
V_2P_1	158.67 a	97.20 a	63.83 bc	19.23
V_2P_2	120.83 b	84.50 bc	76.17 a	19.83
V_2P_3	120.67 b	84.58 bc	61.50 bc	19.33
V_3P_0	112.67 b	78.87 c	54.50 c	20.83
V_3P_1	148.83 a	92.40 ab	66.25 ab	19.63
V_3P_2	148.50 a	104.17 a	69.00 a	18.00
V_3P_3	114.50 b	84.17 b	71.17 a	20.43
V_4P_0	105.17 b	70.93 c	56.17 b	19.50
V_4P_1	115.83 b	81.08 bc	69.33 a	20.50
V_4P_2	139.75 a	97.82 a	62.67ab	19.53
V_4P_3	153.00 a	107.10 a	75.00 ab	18.90
V_5P_0	144.50ab	101.15 a	79.83 a	20.00
V_5P_1	113.50 cd	79.45 b	66.17 bc	20.03
V_5P_2	109.67d	76.70 c	57.75 c	20.67
V_5P_3	128.50 bc	89.95 b	58.00 c	19.87
S.E. (±)	5.73	3.74	3.58	NS

In a column, the figures having same letter do not differ significantly as per LSD at 5% level.

Table 3: Effects of Potassium, Variety and Potassium ´ Variety interaction on yield and yield con tributing parameters of some clones /variety of sugarcane, BSRI, Ishurdi, 2004-05

Variable	Tiller ($\times 10^3$ ha^{-1})	Millable cane ($\times 10^3$ ha^{-1})	Yield (t ha^{-1})	Brix (%)
Potassium level (kg/ha)				
0 (K_0)	129.60 b	89.93 b	74.27	19.01
60 (K_1)	142.40 a	99.71 a	83.73	19.37
90 (K_2)	145.53 a	99.52 a	79.30	19.35
120 (K_3)	140.33 a	98.12 a	77.18	18.95
S.E. (±)	2.95	1.52	NS	NS
Variety				
Isd 34 (V_1)	157.83 a	109.90 a	76.10	18.48 b
I 202/98 (V_2)	149.71 ab	104.77 a	75.28	19.55 a
I 110/97 (V_3)	123.75 d	86.35 b	76.21	19.19 a
I 131/97 (V_4)	128.29 cd	89.77 b	80.92	19.63 a
I 98/98 (V_5)	137.50 bc	93.36 b	84.58	19.01 ab
S.E. (±)	4.57	3.15	NS	0.22
Potassium level × Variety				

V_1K_0	141.17	96.54	68.00	18.03
V_1K_1	144.50	101.15	76.00	19.67
V_1K_2	115.83	80.17	64.00	19.27
V_1K_3	121.67	85.07	80.00	20.03
V_2K_0	124.83	86.73	83.33	18.07
V_2K_1	165.00	115.47	80.17	18.90
V_2K_2	145.83	102.08	76.17	19.27
V_2K_3	132.00	92.53	83.83	19.70
V_3K_0	130.67	91.48	84.17	19.73
V_3K_1	138.50	96.97	94.33	19.27
V_3K_2	151.33	105.93	73.50	18.70
V_3K_3	156.67	109.70	80.83	19.63
V_4K_0	122.67	85.88	83.33	19.07
V_4K_1	139.00	97.30	78.67	20.23
V_4K_2	158.00	98.97	80.17	19.13
V_4K_3	173.83	121.67	82.75	18.27
V_5K_0	151.83	106.13	68.12	19.63
V_5K_1	124.50	86.80	73.67	18.73
V_5K_2	121.83	85.23	80.83	18.53
V_5K_3	129.67	90.77	80.50	19.60
S.E. (±)	NS	NS	NS	NS

In a column, the figures having same letter do not differ significantly as per LSD at 5% level.

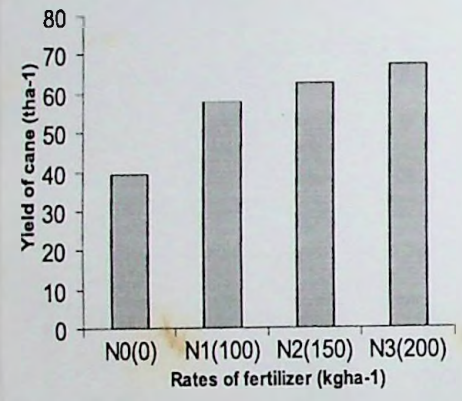

Fig1: Yield response due to application of nitrogenous fertilizer, BSRI, Ishudi, 2004-05

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