*Bangladesh J. Sugarcane*, 16 : 27–31 July, 1994

# Influence of Phosphorus on the Yield and Yield Contributing Parameters of Sugarcane in Tista Meander Floodplain Soils of Bangladesh

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Received on 20.6.93

## ABSTRACT

A field experiment was conducted in the growers field of Tista Meander Floodplain soils of Bangladesh in two consecutive cropping years to study the effects of different levels of P (0, 80, 120, 160 & 200 kg $P_2O_5$/ha) on sugarcane production. Application of P significantly influenced the production of tiller, millable cane, and yield of cane. Production of millable cane and yield was maximum with the application of 120kg $P_2O_5$/ha, beyond which it decreased. No consistent results were obtained on percent recoverable sucrose content of sugarcane. Economics of P fertilizer indicated that maximum return was obtained with the application of 120kg $P_2O_5$/ha in Tista Meander floodplain soils of Bangladesh.

## INTRODUCTION

Sugarcane, a voracious plant requires fairly large quantities of different nutrients for its successful growth and development. Phosphorus plays a vital role in the maturity of plant and it encourages early development of vigorous root system. Besides, phosphorus is a component of nucleic acid and phospholipids in the plant cell and particularly important for energy relationship in the cell. Sugarcane removes a large quantity of phosphorus from the soil. Its deficiency exibits slender cane stalk and poor to no tillering. Kadian *et al.* (1981) observed that application of 50 kg $P_2O_5$/ha increased yield of cane significantly over control. Response of sugarcane to applied phosphorus varies depending on the soil inherent P and adsorption capacity of the soil. In calcareous soils of India, Thakur *et al.* (1979) found a significant effect of P upto 100 kg $P_2O_5$/ha. Lyon and Buckman (1943) stated that phosphorous is important because of its balance influence on potassium and especially on nitrogen. Pannu *et al.* (1989) reported that cane yield rise sharply as a result of P application. Thomas *et al.* (1985) did not obtained any effect of P application on yield of cane. In Bangladesh, Chowdhury and Rahman (1986) reported that application of 130 kg $P_2O_5$/ha increased the cane and sugar yield. However, under Bangladesh condition little work has been done to see the effect of Phosphorus on sugarcane. Considering the above situation this work was undertaken to find out optimum dose of P fertilizer

for sugarcane production and its growth under Tista Meander Floodplain soils of Bangladesh.

## MATERIALS AND METHODS

A field experiment was carried out at farmers field of Tista Meander Fooldplain soils of Bangladesh in two consecutive cropping years of 1989-90 & 1990-91. The soils of the experimental sites were low in total N, organic matter content, exchangeable K, available P and S. The major chemical properties of this soils are presented in the Table 1. There were five treatments viz. O, 80, 120, 160, and 200 kg $P_2O_5$//ha from triple super phosphate, each treatment was replicated four times in RCB design. Recommended rate of N(165 kg N/ha), K(110 kg $K_2O$/ha), S(30 kg S/ha) and Zinc (8 kg Zn/ha) were applied in the form of urea, muriate of potash, gypsum and zinc sulphate respectively. Half of K and full of P, S, and Zn fertilizers were applied in pit at the time of transplantation. After 15d of transplanting of sugarcane setting, half dose of N fertilizer was applied. The rest of N and K were top dressed at 120d after transplantation. Forty five days old sugarcane settings of variety Isd 16 was used as test crop and were transplanted in November each year. Intercultural operations, pest and disease control were done as and when needed. Data on tiller number, millable cane, yield of cane and sugar were recorded.

Soil texture was determined by hydrometer method, organic carbon by wet oxidation method, pH by a glass electrode pH meter and total N by macro kjeldahl method. Available P was determined by using 0.5 M $NaHCO_3$ extraction in spectrophotometer. Exchangeable K was determined by 1M $NH_4OAC$ extraction in flame photometer and available S was determined by turbidimetric spectrophotometer method (Black, 1965).

## RESULTS AND DISCUSSION

The effect of phosphorous on tiller production are presented in the Table 2. It is evident from the results that P fertilizer had a positive effect on tiller production. The maximum number of tiller was produced with the application of 120kg $P_2O_5$ and 80kg $P_2O_5$/ha($214.8 \times 10^3$ and 208 $\times 10^3$) respectively in 1989-90 and 1990-91 cropping years and the results were found significantly higher over control. This result confirms the findings of Islam and Ali (1979) where they found some effect of P on tillering. Millable cane production significantly increased by P application in the first year while the effect was disappeared in the second year. The number of millable cane increased with the increasing level of P up to 120 kg $P_2O_5$/ha in both the years, beyond which production of millable cane decreased. Maximum number of millable cane of 109.1 $\times 10^3$/ha and 85.0 x103/ha produced with 120kg $P_2O_5$/ha in 1989-90 and 1990-90 respectively. Similar result was also obtained by Chowdhury and Rahman (1986). From the Figure 1, it is seen that percent tiller mortality was lower with the incerasing levels of P fertilizer. About 55 to 61 % tillers fail to produce millable cane at harvest in first and second year experimentation.

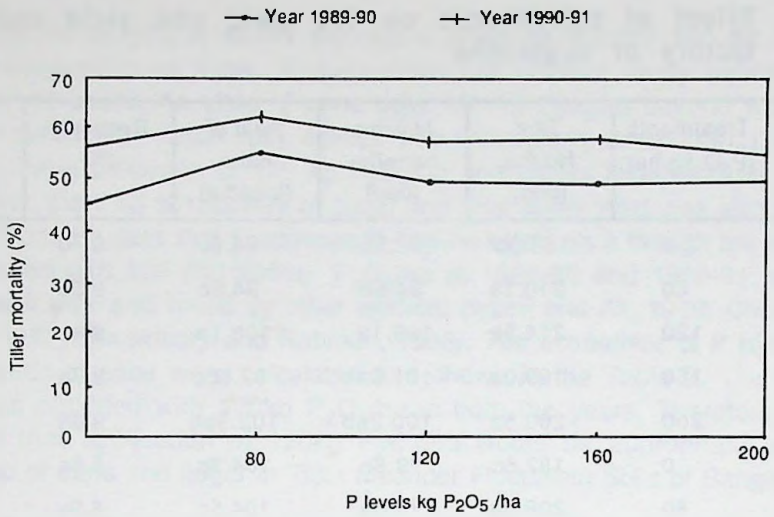


Figure 1. Effect of different levels of P on tiller mortality.

Miah and Sarkar (1982) reported that 54-66% tiller died after attaining the maximum number in May. This high tiller mortality probably due to inter and intra clump competition for nutrient, moisture and sunlight. It is observed from the data that yield of cane significantly increased over control with the application of phosphorous in both the years. Application of 120kg $P_2O_5$ kg/ha produced 108.1 ton cane/ha in 1989-90 cropping season. But in 1990-91, application of 120 kg and 200 kg $P_2O_5$/ha produced 122.4 and 123.3 ton cane/ha respectively. The results are significantly higher over control. Results indicated clear effect of P in this soil. Islam and Ali (1979) also found significant yield increase with P application at the rate of 123 kg/ha.

**Table 1. Some physico-chemical properties of preplanted soil.**

| Year | Texture | pH | Organic carbon (%) | Total N (%) | Availale P (ppm) | Exchange-ble K (meq%) | Available S (ppm) |
|---|---|---|---|---|---|---|---|
| 1989-90 | Sandy loam | 6.3 | 0.71 | 0.061 | 9.0 | 0.11 | 3.0 |
| 1990-91 | Sandy loam | 6.1 | 0.63 | 0.052 | 11.0 | 0.14 | 5.0 |

**Table 2. Effect of phosphorus on the yield and yield contributing factors of sugarcane.**

| Crop Year | Treatments ($P_2O_5$kg/ha) | Tiller No./ha (ooo) | Millable cane/ha (ooo) | Yield of cane (tons/ha) | Recovery (%) | Yield of sugar (tons/ha) |
|---|---|---|---|---|---|---|
| 1989-90 | 0 | 168.3b* | 92.5b | 94.8c | 8.7b | 8.2 |
| | 80 | 210.1a | 94.5b | 94.5c | 9.5a | 9.0 |
| | 120 | 214.8a | 109.1a | 108.1a | 9.4a | 10.1 |
| | 160 | 199.0a | 101.9ab | 97.0bc | 9.7a | 9.4 |
| | 200 | 200.5a | 100.2ab | 102.9ab | 9.8a | 10.1 |
| 1990-91 | 0 | 182.6c | 79.8a | 104.3c | 8.8a | 9.2 |
| | 80 | 208.0a | 79.5a | 104.5c | 8.9a | 9.3 |
| | 120 | 197.0b | 85.0a | 122.4a | 9.1a | 11.2 |
| | 160 | 192.3b | 81.1a | 108.6b | 9.0a | 9.8 |
| | 200 | 180.0c | 80.5a | 123.3a | 9.3a | 11.5 |

*Figures accompanied by the same letters do not differ significantly at 5% level as per DNMR test.

**Table 3. Economics of P fertilizer use.**

| Year | $P_2O_5$ (kg/ha) | Fertilizer cost (Tk.) | Yield of cane (tons/ha) | Additional yield (tons/ha) | Additional income due to P fertilizer (Tk.) | Net income due to P fertilizer (Tk.) |
|---|---|---|---|---|---|---|
| 1989-90 | 0 | | 94.8 | | | |
| | 80 | 996 | 94.5 | -0.3 | -317.0 | -313.2 |
| | 120 | 1500 | 108.0 | 13.3 | 13164.5 | 11664.5 |
| | 160 | 1990 | 97.0 | 2.2 | 2180.9 | 190.9 |
| | 200 | 2502 | 102.9 | 8.1 | 7999.8 | 5497.8 |
| 1990-91 | 0 | | 104.3 | | | |
| | 80 | 996 | 104.5 | 0.2 | 237.9 | 758.1 |
| | 120 | 1500 | 122.4 | 18.1 | 17932.6 | 16432.6 |
| | 160 | 1990 | 108.6 | 4.3 | 4242.8 | 2252.8 |
| | 200 | 2502 | 123.3 | 19.1 | 18884.8 | 16382.3 |

Price of fertilizer (TSP) : Tk. 6.00 per kg.
Price of sugarcane : Tk. 991.30 per ton.

Thakur *et al.* (1979) found significant effect of P upto 100 kg $P_2O_5$/ha in noncalcareous soils of India. Results from the present study indicated that P application increases the yield of cane upto 120 kg $P_2O_5$/ha beyond which yield of cane decreased. The result fully agrees with Chowdhury *et al.* (1982), where they found a positive influence of 125 kg $P_2O_5$/ha and higher level of P fail to produce more benefit. Data on % recovery of sugar and total sugar yield was also studied and it is clear from the data that P application had no effect on it though the highest TSH was produced with 120 and 200kg $P_2O_5$/ha in 1989-90 and 1990-91 respectively. Similar result was also found by other workers (Islam and Ali, 1979; Chowdhury and Rahman, 1982; Chowdhury and Rahman, 1986). The economics of P fertilizer of the marginal yield of cane were calculated and shown in the Table 3. The highest net benefit was obtained with 120kg $P_2O_5$/ha in both the years. Therefore, it may be concluded that application of 120kg $P_2O_5$/ha would be appropriate in obtaining higher yield of cane and sugar in Tista Meander Floodplain Soils of Bangladesh.

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