Bangladesh J. Sugarcane, **10 :** 41-46. July, 1988

Response of Plant Nutrients on Noncalcareous Soils of Setabganj

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ABSTRACT

Nutrient requirement of sugarcane have been determined through field experiments in noncalcareous soils of Setabganj Sugar Mills (STSM) farm. Differential response of applied plant nutrients was observed on sugarcane yield, sucrose content and sugar yield. The effects of nitrogen were most marked on cane and sugar yield. Phosphorus application had no effect on cane and sugar yield. But potash application showed positive response on yields. Sulphur increased yield of cane and sugar over control and the difference was found statistically significant. Leaf nutrient concentration was found higher at tillering stage than at harvesting. The different fertilizer showed no effect on sucrose content of cane. The treatment N_2PKS (120 kg N, 130 kg P_2O_5, 110 kg K_2O and 30 kg S/ha) was found to be most economic fertilizer dose in this study.

INTRODUCTION

Nitrogen, phosphorus and potash are the major essential elements for plant growth. These elements have received universal acceptance as a required supplement for this purpose. Besides, sulphur and zinc are also required for optimum yield of sugarcane. Nitrogen deficiency early in the growing season decrease cane yield, while excess N at ripening stage reduces juice quality and sucrose content (Samuels, 1963; Thomas and Salinas, 1976). Standford and Ayres (1964) reported that sugarcane required about 1 kg of N for each metric ton of millablecane. According to Lyon (1943) phosphorus is important because of its balance influence on potassium and especially on nitrogen. Similarly Thomas et al. (1985) did not obtain any increase either phosphorus contents of leaves, nor the yield of cane, when applied phosphorus fertilizers. Potassium has been reported for its important role in sugar formation. Dagade (1976) found 100 kg K_2O/ha optimum rate of K for higher yield of cane. Research on S and Zn nutrition has been started in recent years in Bangladesh. Sulphur deficiencies have been reported in Puerto Rico (Bonnet, 1967) in Louisiana (Golden, 1972) and in Bangladesh (Chowdhury et al., 1984). Fox (1976) found requirement of sulphur at the rate of 40 kg S/ha for 247 ton/hectare of millablecane. Golden (1977) reported that application of Zn did not show any effect on cane or sugar yield. Therefore, an investigation was undertaken to study the response of essential elements on the yield of cane and sugar.

MATERIALS AND METHODS

The experiment was conducted at Setabganj Sugar Mills (STSM) farm of Dinajpur district during 1981-82 cropping season. Physical and chemical properties of soils of this location from a depth of 20 cm were sandy loam, pH 6.0, organic carbon 0.74%, total N 0.042%, available P 35ppm, exch. K 0.12 (m.e.%) and available S 8 ppm.

The experiment was laidout following RCB design with nine treatments, replicated 4 times. the variety lsd-2/54 was used as test crop. the treatment combinations were as follows :

1. Control
2. N_1
3. N_2
4. N_2P
5. N_2PK
6. N_2PKS
7. N_2PKZn
8. N_2PKSZn
9. N_3PKSZn

Where,
Control= no fertilizer
N_1 = 60 kg N/ha from urea.
N_2 = 120 kg " "
N_3 = 180 kg " "
P = 130 kg P_2O_5/ha from TSP
K=110 kg K_2O/ha from MP
S=30 kg S/ha from Gypsum
Zn= 8 kg Zn/ha from Zinc-oxide.

After proper preparation of land whole quantity of P,S, Zn and 50% of N & K were applied in the trenches. the remaining 50% of N & K were top-dressed at boom growth stage. Plot size was 8m×7m. the cane was planted in November, 1981 and harvested in December, 1982. All agronomical practices were done as and when required. Yield perplot was recorded, sucrose content of cane was determined at harvest and sugar yield was calculated on the baais of sucrose content and cane yield. For each sample, 3-6 leaf blades counting from the top to downwards for N,P,K & S determination. The sampling was done at tillering stage (5 months old) and at harvest stage (14 months old).

Particle size distribution was determined by hydrometer method; soil pH was measured in soil : water suspension at 1 :2.5 by glass electrode; total-N was determined by Kjeldhal method (Jackson, 1973), organic carbon by Walkley and Black (1947) wet oxidation method; available - P ($NaHCO_3$ extractable) and total-P (ternary acid digest) by standard ammonium molybdate of Olsen's (Black, 1965); exchangeable-K ($NH0_40OAC$ extractable)and total-K (ternary acid digest) by flame photometer (Black, 1965) and available-S (NH_4OAC extractable) and total-S (di-acid digest) by turbidimetric method of Bardsley (Black, 1965).

RESULTS AND DISCUSSION

Yields of cane and sugar are shown in Figures 1 and 2 respectively. Yield of both cane and sugar was increased as the nitrogen levels was increased upto 120 kg N/ha and there was not further increase in yield, when 180 kg N/ha was applied incombination with PKSZn. The Figures 1 and 2 show that application of 120 kg N/ha produced higher cane and sugar yield compared to 60 kg N/ha and control. The cane yield was increased by 21% and 26% over control due to the application of 60 kg and 120 kg N/ha respectively. Significant yield increase due to application of nitrogenous fertilizers was reported by many authors (Samuels, 1965; Thakur et al. 1981 and others). Figures 1 & 2 show that the yield of cane and sugar did not increase when 130 kg P_2O_5/ha was applied incombination with 120 kg nitrogen. Cover and Lope (1965) reported that they did not record any response of phosphatic fertilizer application in the sugarcane field when soil contained 30 ppm phosphorus. They also reported that soils contain below 30 ppm phosphorus requires heavy to light application of phosphatic fertilizers. Initial soils of the above study contain 35 ppm available P. According to cover and Lope (1965) it can be concluded that due to

high level of available phosphorus in soil, further application of phosphorus showed no effect on the yields. Phosphorus might not be absorbed by the plants and could be fixed in the soil.

The Figures 1 and 2 also show that the application of potash in combination with N_2P produced higher yield over N_2P treatment. Jafri *et al.* (1978) obtained higher yield with 70 kg K_2O application in India. The yield of both the cane and sugar was further increased when sulphur was added at the rate of 30 kg S/ha with NPK at the above mentioned rates. The sulphur was applied in the form of gypsum. The positive yield response of sulphur was reported by Golden (1983). Zinc application showed negative response on cane and sugar yield. Zinc suppressed effects of NPK. Effect of sulphur also suppressed by zinc application at the rate of 8 kg/ha. Results showed that N,K and S have positive response on cane and sugar yield at Setabganj area while zinc showed negative effect. Results suggest not to use any zinc in area of Dinajpur district.

Table 1. Effects of fertilizers on nutrient concentration of sugarcane leaves.

Treatment	Total N(%)		Total P(%)		Total K(%)		Total S(%)	
	Tiller-ing stage	Harves-ting stage	Tiller-ing stage	Harves-ting stage	Tiller-ing stage	Harves-ting stage	Till-ering stage	Harve-sting stage
Control	0.88	0.38	0.066	0.027	0.65	0.60	0.24	0.10
N_1	1.01	0.67	0.083	0.050	0.73	0.68	0.25	0.10
N_2	0.92	0.50	0.081	0.050	0.60	0.55	0.23	0.11
N_2P	0.93	0.68	0.089	0.060	0.59	0.54	0.24	0.10
N_2PK	0.95	0.76	0.079	0.052	0.88	0.80	0.23	0.09
N_2PKS	1.06	0.80	0.093	0.059	0.92	0.83	0.25	0.12
N_2PKZn	1.05	0.77	0.088	0.059	0.80	0.75	0.23	0.09
N_2PKSZn	1.05	0.80	0.088	0.058	0.78	0.55	0.24	0.09
N_3PKSZn	1.13	0.96	0.097	0.057	0.96	0.88	0.25	0.11

The results in the Table 1, show the effect of different fertilizers on the contents of different elements of leaves at tillering (5 months old) and harvesting (14 months old) stage. It has been recorded that the concentrations of nutrients were higher at tillering stage than that of harvesting stage. It is evident from the results that the nutrient elements absorption were gradually decreased with increased age of sugarcane (Table 1). Sulphur content of leaves at harvest stage were found less than 50% of tillering stage. Changes of potash content of 5 months old plants to 14 months old plants were small compare to other nutrient elements. It has been shown in the Table 1 that application of S and Zn slightly increased N concentration in the leaves. K application also increased the uptake of K and N nutrient. Therefore, this results indicates that higher yield was possible due to higher uptake of N element. Phosphorus application did not increase P level in the leaves and the levels were below the critical level (0.20-0.22%) reported by Dutoil (1959). Potash application increased K concentration in the leaves and also increased yield of cane. Sulphur application did not increase S concentration in the leaves although increased both cane and sugar yield. This yield increase was possible, possibly because of higher uptake of N at both growth stages and higher P uptake at tillering stage due to S

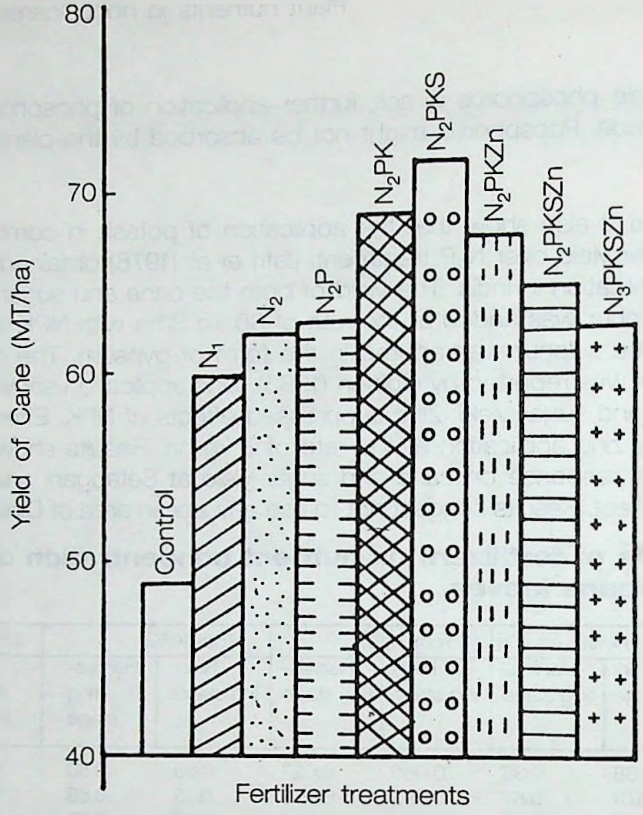

Figure 1. Effect of fertilizers on cane yield.

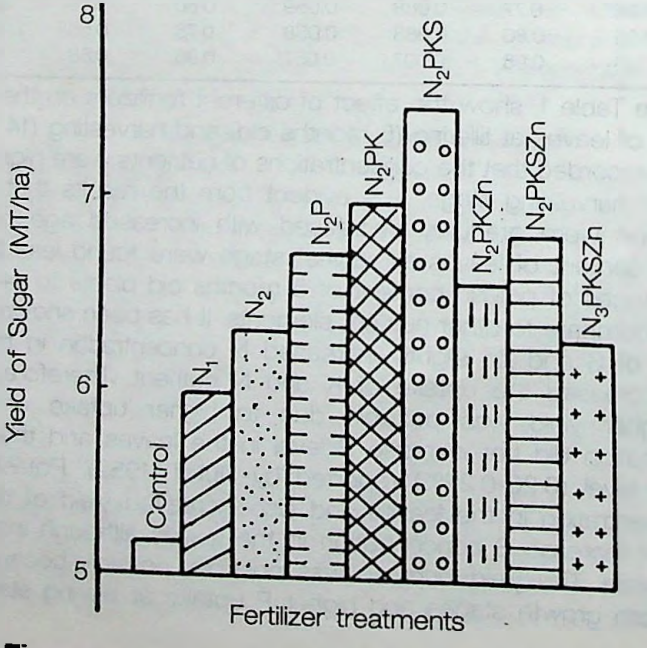

Figure 2. Effect of fertilizers on sugar yield.

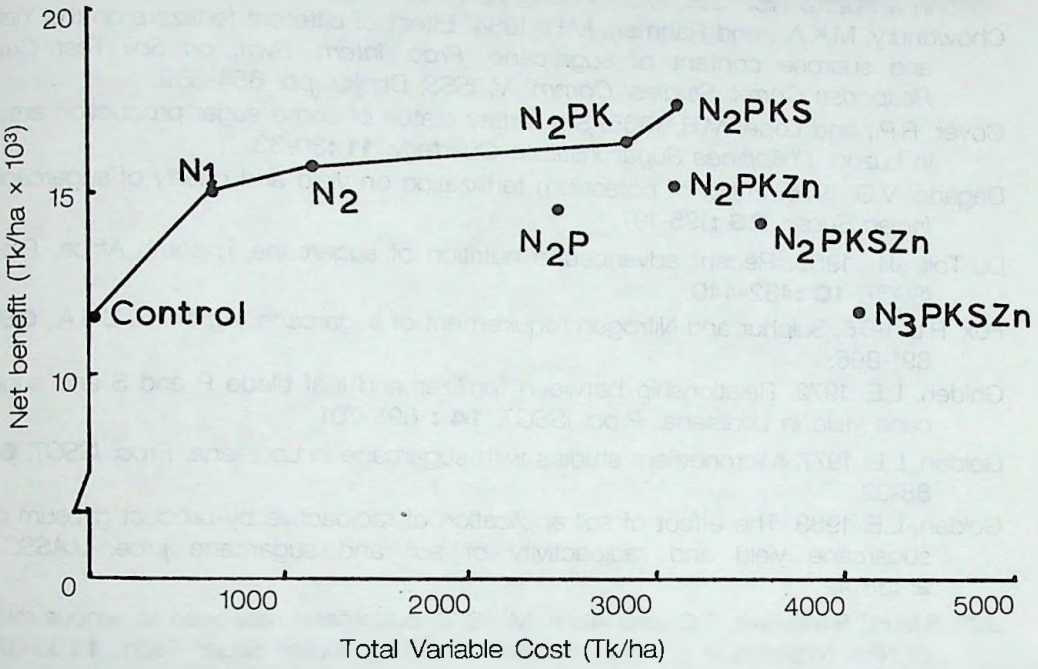

Figure 3. Net benefit curve for the fertilizer trial on sugarcane.

application. Sedl (1971) obtained 0.132 to 0.295% S in the sulphur free treatment while Fox (1976) reported 0.138 to 0.232% S in the leaf blades of sulphur fertilized sugarcane.

Economic analysis on the yield of sugarcane in response to different doses of different fertilizers has been shown in Figure 3. Nitrogen, potash and sulphur application gave higher net benefit over other elements. The N_1 and N_2PKS treatments showed higher marginal rate of return to added fertilizer cost and highest net profit was obtained with N_2PKS treatment. Application of P in the Setabganj area found to be uneconomic and Zn application would be lossing. For balance fertilization and to obtain economic benefit we do recommend for application of 120 kg N, 130 kg P_2O_5, 110 kg K_2O and 30 kg S/ha for sugarcane production in the STSM area.

ACKNOWLEDGEMENTS

The authors are grateful to the Bangladesh Agricultural Research Council, Dhaka for sponsoring the project entitled ' Soil Test Crop Response Correlation Studies for Sugarcane' under which the investigation was made. Thanks are due to Mr. M.A. Ghafur and Mr. M.A. Jabber for statistical and chemical analyses respectively.

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