Bangladesh J. Sugarcane, 7:65-69 *July, 1985*

Effect of N,P,K,S and Zn Fertilization on the Yield of Sugarcane at Rajshahi

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ABSTRACT

Field experiments with different nutrient elements were conducted during cropping seasons of 1981-82 and 1982-83 on the calcareous soil of Rajshahi Sugar Mills farm (Ganges river flood plain). Different fertilizer elements caused significant changes in sugarcane . yield. Nitrogen alone had a significant effect on cane yield. Addition of P to the treatment of N_2 increased the cane yield at about 7% . But K inclusion to N_2P decreased the yield in both the years. Effect of S were more prominent and distinct compared to other nutrient elements. Zinc showed small response. Highest yield of cane and sugar were obtained with N_2PKS (120 kg N, 130 kg P_2O_5, 110 kg K_xO and 30 kg S/ha) treatment. Highest net profit was also found with the same treatment.

INTRODUCTION

Balanced fertilization is a prerequisite for harnessing optimum yield potential of any crop. A good number of work on sugarcane fertilization mainly on N, P & K have been carried out in most of the sugarcane growing countries of the world. In Bangladesh very little works have been reported on zinc and sulphur responses (BARC, Annual Report, 1982). Fasihi *et. al.* (1980) found economic yield of cane at 112 kg N/ha application. Yadab (1980) observed that higher cane yield was obtained when applied 150 kg N/ha in Uttar Pradesh and 120 kg N/ha in Bihar, India. Thakur *et. al.* (1979) reported that sugarcane responded to P upto 100 kg P_2O_5/ha in normal calcareous soils and 50 kg P_2O_5/ha in saline alkali soils of India. Results indicated that cane and sugar yield rose with K rate by comparison with the untreated controls, but the optimum was 100 kg K_2O/ha (Dagade, 1976). Yonemitsu (1968) compiled the results of field experiments and reported significant increase due to sulphur fertilization. Juang *et. al.* (1974) reported the response of zinc application to sugarcane, on soils with less than 3 ppm Zn. Hence, an attempt was made to findout the response of N, P, K, S and Zn to sugarcane at Rajshahi sugarcane growing soils.

MATERIALS AND METHODS

Field experiments were conducted at Rajshahi Sugar Mills farm, Rajshahi in 1981-82 and 1982-83 cropping seasons. Major properties of soils are given in Table 1. The experiment was laidout in a randomized complete block design with nine treatments replicated four times. The treatment combinations were as follows :– Control, N_1, N_2, N_2P, N_2PK, N_2PKS, N_2PKZn, N_2PKSZn and N_3PKSZn. Rates of fertilizers used were,nitrogen @ 60 kg (N_1), 120 (N_2), and 180 (N_3), kg N/ha ; phosphorus @ 130 kg P_2O_5/ha, Potassium @ 110 kg K_2O/ha ; Sulphur @30 kg S/ha and Zinc @8 kg Zn/ha as urea, TSP, MP, Gypsum and Zinc oxide respectively. All the fertilizers P, S, Zn, half K and half N were applied in the trenches before planting. The remaining half N and half K were applied at maximum tillering stage. The unit plot size was 8mX7m.

Table 1. Some properties of initial soils.

Year	Texture	pH	Total-N %	Organic-C %	Available P(ppm)	Exch.-K m.e./100 gm	Available S (ppm)
1981-82	Clay loam	7.2	0.038	0.54	9	0.11	12
1982-83	Loamy sand	8.0	0.052	0.37	16	0.13	4

Isd-2/54 cane variety was used in the experiment. The sugarcane setts were planted in November each year and harvested at 14th months age. Intercultural operations like, mulching and weeding were done as needed. Proper pest and disease control measures were taken in due time. Yield of cane per plot were recorded, sucrose content of cane were determined at harvest and sugar yield (kg/plot) were calculated.

Particle size distribution was determined by hydrometer method, soil pH was measured in soil: Water suspension at 1:2.5, total-N was determined by Kjeldhal method, organic carbon by wet oxidation method, available-P ($NaHCO_3$ extractable) and total (ternary acid mixture digest) by standard ammonimum molybdate, exchangeable-K (Ammonium acetate extractable) and total (ternary acid digest) by Flame photometer and available-S ($NaHCO_3$ extractable) and total (di-acid digest) by turbidimetric method.

RESULTS AND DISCUSSION

Data on yield of cane and sugar were presented in Table 2. Addition of nitrogen caused significant increases in the yield of cane and sugar. N-alone at the recommended dose of 120kg N/ ha caused a mean yield increase of 30%over control. Panwar *et. al.* (1980) also observed increase in cane yield with the application of nitrogen. It is evident from the data that cane yield and sugar yield were significantly increased with the addition of P over control,but insignificant over N_2 treatment. It may be worth noting that the cane and sugar yield at N_2PK treatment was slightly lower than that of N_2P. Results indicated that potash application did not improve the cane yield over P. The experiment was conducted at SRI during 1976-77 season with different levels of NPK fertilizer showed that the highest yield was obtained at $N_3P_2K_0$ treatment i.e. where 150 lbs N and 150 lbs P_2O_5 per acre with no K were applied (SRTI Annual Report, 1979). Ali *et. al.* (1984) also found depressed yield of wheat at Ishurdi when applied K with NP. Fitts (1983) reported that the soils under study was high in degaraded mica which could quickly react with any K applied in a soluble form and cause difficult in trying to extract it. This might be one of the causes of the depressing effect of K. However, this needs to be thoroughly investigated further.

A perusal of data presented in Table 2, indicates that marked significant responses of cane and sugar yield was observed when S was added to the N_2PK treatment at the rate of 30kg S/ ha. Addition of Sulphur increased yield of cane at about 60% over control and 22% over N_2PK, where control, N_2PK and N_2PKS treatments registered 49.65 TCH, 65.05 TCH and 79.43 TCH respectively. Hasan (1976) obtained higher yield with gypsum application.Zinc application also increased the yield of cane at about 42 % and 9 % over control and N_2PK treatments respectively. Ahmed *et. al.* (1975) obtained beneficial effect of Zn on yield and quality of sugar cane when applied at 2kg Zn/ ha. Combined effect of S and Zn with NPK failed to increase the yield of cane and sugar over S application with N_2PK.It may be concluded that N, P, S and Zn had a beneficial effect on cane and sugar yield at Rajshahi. But significant response showed only N and S.

Table 2. Effect of different nutrients on the yield of cane and sugar.

Treatment	Yield of cane (t/ha)			Yield of sugar (t/ha)		
	1982	1983	Mean	1982	1983	Mean
Control	59.37	39.93	49.65 a*	5.23	3.37	4.30 a*
N_1	66.40	55.56	60.98 b	5.92	4.82	5.37 b
N_2	71.09	57.79	64.44 b	6.43	4.57	5.50 bc
N_2P	71.57	66.11	68.84 bc	6.40	5.60	6.00bcde
N_2PK	67.36	62.77	65.07 b	5.99	5.66	5.83 bcd
N_2PKS	81.28	77.57	79.43 c	6.99	6.35	6.67 e
N_2PKZn	76.85	64.06	70.46 bc	6.58	5.32	5.95 bcde
N_2PKSZn	87.73	63.72	75.73 c	7.23	5.34	6.29 cde
N_3PKSZn	86.28	67.46	76.87 c	7.42	5.28	6.35 de

* Figures containing the same letters are not significantly different at 5% level probability as per DNMR test.

Table 3. Nutrient contents of sugarcane leaf as affected by different treatments (mean of 2 years).

Treatment	Total-N (%)	Total-P (%)	Total-K (%)	Total-S (%)
Control	0.81	0.03	0.74	0.11
N_1	0.93	0.04	0.75	0.10
N_2	1.00	0.04	0.78	0.11
N_2P	1.02	0.04	0.83	0.12
N_2PK	1.01	0.04	0.85	0.11
N_2PKS	1.02	0.04	0.79	0.13
N_2PKZn	0.98	0.04	0.84	0.11
N_2PKSZn	0.97	0.04	0.87	0.14
N_3PKSZn	1.08	0.05	0.84	0.13

Nutrient content (mean) of sugarcane leaf as affected by different treatments are presented in Table 3. The data in Table 3 show that application of nitrogen increased the N content of leaf in all observations. Highest recovery of N was found at 180 kg N/ha application. Different nutrient elements did not bring any change of P concentrations. High dose of N slightly increased the P concentrations. The potash contents of leaf ranged from 0.74 to 0.87 percent. Increased of K contents of N_2PK treatment over N_2P is negligible. Sulphur application decreased the K concentrations of leaf. Highest accumulation of K and S were found with N_2PKSZn treatment. S application increased the S concentrations. From these observations it could be assumed that higher concentrations of nutrients was accompanied by the higher yield of cane.

The partial budget analysis of the mean yields of sugarcane show that the N_2PKS treatment gave the highest net benefit (Fig. 1) where the marginal increase in net benefit due to applied S to N_2P treatment (Tk. 3,496.00) with the marginal increase in variable cost (Tk. 740.00) which ultimately gives a marginal rate of return of 4.72. N_1 application alone brought 4.54 marginal rate of return. Addition of P brought small returns. The net benefit curve initially rises steeply with nitrogen, then very slowly rise with the addition of P, but falls with the addition of K. It rises again with the addition of S. This indicates acute deficiency of S in this area limiting the response of K and Zn. Addition of P or PK to the N_2 treatment is not economical unless S was added. But K application is essential only for the maintenance of fertility of the soils. It clearly indicates that the N_2PKS treatment would be the most economic for optimum sugarcane production in this soil condition.

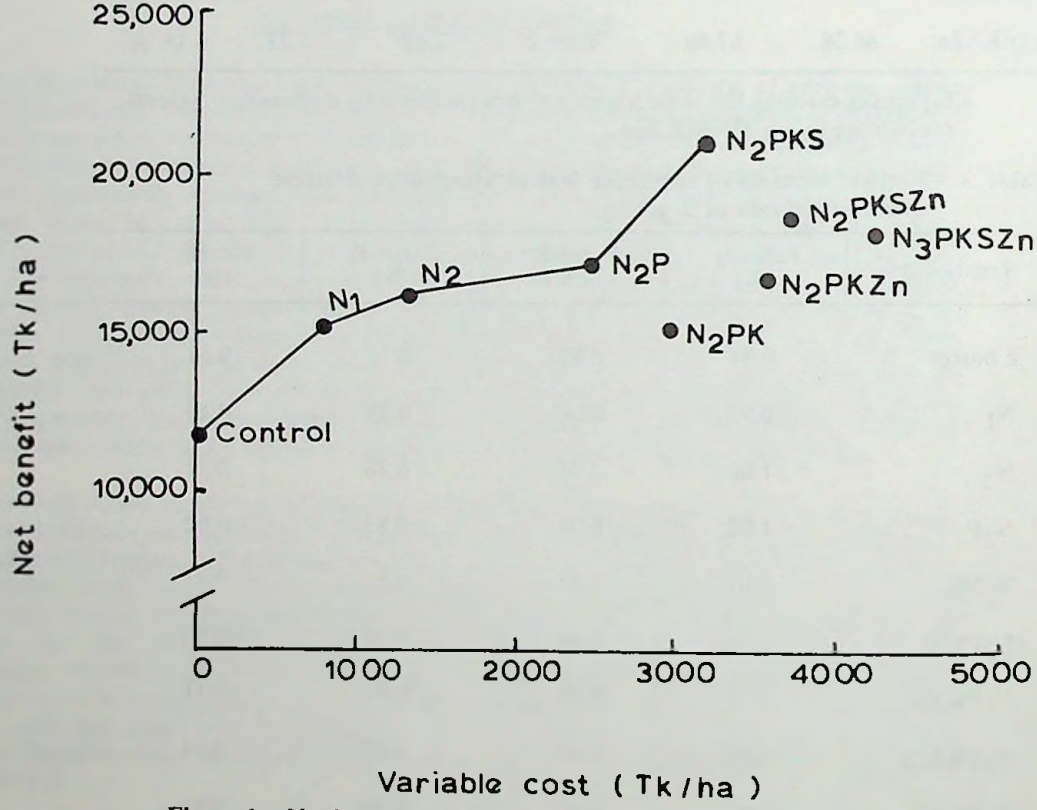

Figure 1. Net benefit curve for different treatments (2 yrs mean).

ACKNOWLEDGEMENTS

The senior author is 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, Asstt. Statistician and Mr. M. A. Jabber, Asstt. Sugar Chemist for statistical and Chemical analysis respectively.

REFERENCES

Ahmed, S. A., Narasimhan, K. T., Ramomoorthy, N. ; Swayanprokasam, S. A. and Rajan, S. D. 1975. Studies on the efficacy of micronutrient application for sugarcane in the Cuddalore tract. *Indian Sugar*, **25**(5) : 395-399.

Ali, M. I. Bhuiyan, E. H. and Razzaque, A. H. M. 1984. Yield response and fertilizer economy of a semi - dwarf wheat variety to fertilization on some soils of Bangladesh. *Proc.* International Symposium on Soil Test Crop Response Correlation Studies, Commission-IV, ISSS, Dhaka, pp. 410-434.

BARC Annual Report, 1982. The first Annual Report of Coordinated Soil Test Crop Response Correlation Studies, 1980-1981. BARC, Dhaka, pp. 22-76.

Dagade, V. G. 1976. Effect of Potassium fertilization on yield and quality of Sugarcane. *Indian Sugar*, **26** (6): 195-197.

Fasihi, S. D., Malik, K. B. and Renss, J. O. 1980. Studies on the effect of various N and irrigation levels on the yield of sugarcane varieties BL. 4 and L.116. *Proc. ISSCT*, **XVII** Congress, Manila, pp. 52-61.

Fitts, J. W. 1983. Personal communication. Agro. Services International, Inc.

Hassan, S. I. 1976. Soil improvement and yield of sugarcane in the Sudan. *Int. Sugar. J.*, **28** (390): 165-167.

Juang, T. C., Isobe, M. and Uchara, G. 1974. Test for zinc in sugarcane soils of Hawaii. *Proc. ISSCT*, XV Congress, Durban, South Africa, **2** : 859-904.

Panwar, B. S., Rathee, D. N. and Joon, R. K. 1980. Effect of graded doses of nitrogen on growth, yield and quality of sugarcane varieties. *Indian sugar*, **30** (9) : 1-4.

SRTI Annual Report, 1979. The Annual Report of 1973-1978. Sugarcane Research Institute, Ishurdi, Pabna, Bangladesh, pp. 65-67.

Thakur, K., Bose, P. K. ; Sahi, B. P. and Raysharma, R. P. 1979. Response of sugarcane to nitrogen and phosphate in calcareous soils. *Indian Sugar*, **29** (5): 277-280.

Yadab, R. L. 1980 Application of nitrogenous fertilizers to sugarcane crop. *Indian Sugar Crops J.*, **7** (1): 3-5.

Yoshimitsu, I. 1968. Sulphur requirement of sugarcane. Hawaiian Sugar Technologists. 26th Annual Conference. Honolulu, Hawaii, Nov. 13-16, 1967 ; pp. 24-29.