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Effect of Sulphur on Growth, Yield and Sucrose Content of Sugarcane in Ganges River Flood Plain Soils of Bangladesh

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ABSTRACT

An experiment was conducted at the different locations viz. Rajshahi Sugar Mills (RJSM) farm, Sugarcane Research and Training Institute (SRTI) and Carew & Co. during cropping season 1986-87 following randomized block design to study the effect of sulphur on different growth parameters of sugarcane. The highest germination, tillers, millable canes and yield of cane and sugar were obtained where 40 kg S/ha was applied in all locations. Further increase of sulphur application decreased both cane and sugar. No effect of sulphur was found on recoverable sugar in any locations. Sulphur fertilization increased marginal economic benefit.

INTRODUCTION

Sugarcane is an exhaustive crop. Balanced fertilization is very important for its proper growth and development. The effects of sulphur deficiencies are chlorosis of the leaves, slender stalks and lower yield of cane (Rahman *et. al.* 1987). Sulphur deficiencies in Bangladesh soils are widespread and response to its application have been reported on different crops. Laboratory, green-house and field studies have shown that sulphur is a limiting factor in Bangladesh soils and significant positive yield was obtained when sulphur was added to soils (Islam *et. al.* 1984). A 85 ton cane per hectare might remove about 25.44 kg S/ha. The critical level of sulphur in Bangladesh soil was found to be 14 ppm (Portch and Islam, 1984) whereas in cane leaves it varied about 0.14 to 0.20% (Anon., 1967). Clements (1971) reported that sulphur deficiency was found where soil pH ranged from 5.8 to 6.5, low organic matter content and long term use of chemical fertilizer contained no sulphur. Yonemitsu (1968) compiled the results of field experiment and reported significant increase in yield due to sulphur fertilization.

Inspite of the above situation no systematic work has so far, been carried out on the requirement of sulphur for sugarcane in Bangladesh. Therefore, the present investigation was undertaken to find out the effect of sulphur on growth, yield and sucrose content of sugarcane in Ganges River Flood Plain soils of Bangladesh.

MATERIALS AND METHODS

An experiment was conducted at three different locations viz. Rajshahi Sugar Mills farm (RJSM), Sugarcane Research and Training Institute farm (SRTI) and Carew & Co. farm, Darsana During 1986-87 to study the effect of sulphur on different growth parameters of sugarcane.

The experiment was set up following randomized complete block design with four replications, and three eyed assorted setts were planted in trenches. The treatments used were 0, 20, 40, 60 and 80 kg S/ha and the source of S was gypsum.

Soils of Rajshahi, Ishurdi and Darsana are calcareous pale brown, calcareous dark grey, and calcareous brown flood plain respectively. The major properties of these soils are presented in the Table 1. Sugarcane variety Isd-2/54 was used at RJSM and Carew, whereas Isd-16 was used at SRTI.

Full doses of P and S and half of N and K were applied in trenches at the time of plantation and the rest half of N and K were applied after 120-150 days of plantation as top dressing. Soil samples were collected before setting up of the experiment to determine its texture, organic carbon, pH, CEC, total N, available P, exchangeable K and available S. Post harvest soil samples were also collected and analysed for the determination of different nutrients status of that soil.

Table 1. Properties of initial soil.

Locations	Texture	pH	Organic carbon (%)	Total N (%)	Available P (ppm)	Exchangeable K (m.e.%)	Available S (ppm)
RJSM	Sandy loam	7.4	0.62	0.058	13.18	0.13	2.42
SRTI	Loam	7.6	0.69	0.060	13.10	0.14	1.77
Carew & Co.	Sandy loam	7.6	0.52	0.057	14.00	0.16	3.90

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

RESULTS AND DISCUSSION

Results obtained at different locations of the present experiment are presented in Tables 2,3,4 and in Figure 1. It appears from the results that the highest germination, tillers, millable cane, yield of cane and sugar were found where 40 kg S/ha was applied in all locations. Similar results were reported else where (Rahman *et al*, 1986; 1987; Gravois and Golden, 1984; and Saha *et al*, 1984). Cane and sugar yield were increased with the increasing rate of sulphur until 40 kg S/ha, and further increase of sulphur over 40 kg S/ha decreased both cane and sugar yield. The yield variation of cane might be due to varietal effects as well as inherent properties of soil. Sulphur application did not influence the sucrose content of cane, and higher yield of sugar was obtained due to higher yield of cane. Similar results were also obtained earlier (Chowdhury and Rahman, 1984; Saha, *et al* 1984).

Table 2. Effect of sulphur on different growth parameters of sugarcane on Ganges River Flood Plain Soils at RJSM.

Treatments (kg/ha)	Germination (%)	No. of tiller /ha('000')	No. of millable cane/ha ('000')	Yield of cane/ha (TCH)	Recovery (%)	Yield of sugar/ha (TSH)
S_0	42.25 ab	178.35 a	80.00 a	92.44 a	9.94 a	9.24 a
S_{20}	35.25 b	171.83 a	88.12 a	97.87 a	9.55 a	9.31 a
S_{40}	45.25 b	183.58 a	96.56 a	101.81 a	9.79 a	10.00 a
S_{60}	38.25 ab	156.92 a	81.25 a	100.94 a	9.86 a	9.92 a
S_{80}	38.50 ab	169.82 a	95.00 a	98.94 a	9.98 a	8.89 a

* Figures accompanied by same letters are not significantly different at 5% level of probability.

Table 3. Effect of sulphur on different growth parameters of sugarcane on Ganges River Flood Plain Soils at SRTI.

Treatments (kg/ha)	Garmination (%)	No. of tiller /ha('000')	No. of millable cane/ha ('000')	Yield of cane/ha (TCH)	Recovery (%)	Yield of sugar/ha (TSH)
S_0	30.01 b	94.75 b	52.10 b	61.52 b	11.39 a	7.01 b
S_{20}	33.09 ab	105.81 ab	59.28 ab	58.75 bc	11.11 a	6.53 bc
S_{40}	35.21 a	106.83 ab	67.22 a	79.86 a	11.01 ab	8.79 ab
S_{60}	33.03 ab	97.23 ab	60.49 b	67.58 b	10.92 ab	7.38 b
S_{80}	33.10 ab	100.94 ab	61.04	64.65 b	11.00 ab	7.11 b

Figures accompanied by the same letters are not significantly different at 5% level of probability.

Table 4. Effect of sulphur on different growth parameters of sugarcane on Ganges River Flood Plain Soils at Carew & Co.

Treatments (kg/ha)	Germination (%)	No. of tiller /ha ('000')	No. of millable cane/ha ('000')	Yield of cane/ha (TCH)	Recovery (%)	Yield of sugar/ha (TSH)
S_0	28.31 b	75.46 c	47.68 ab	61.25 ab	9.38 a	5.73 b
S_{20}	32.01 ab	91.74 ab	39.05 b	64.22 ab	9.80 a	6.00 ab
S_{40}	36.17 a	99.09 a	50.22 a	77.68 a	9.86 a	7.63 a
S_{60}	34.95 ab	93.62 ab	49.11 a	67.59 ab	9.42 a	6.39 ab
S_{80}	32.81 ab	94.29 ab	42.42 ab	54.55 b	9.42 a	5.13 b

Figures accompanied by same letters are not significantly different at 5% level of probability.

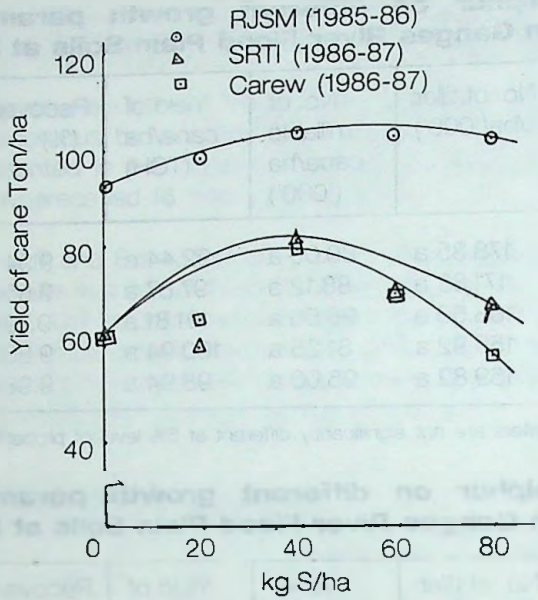

Figure 1. Effect of sulphur on sugarcane.

Table 5. Partial budget analysis for sulphur fertilization on sugarcane production.

Locations	Treatment (kg S/ha)	Cost of sulphur fertilizer Tk/ha	Yield of cane (TCH)	Marginal production over control (Ton)	Marginal income over control	Net benefit (Tk/ha)
RJSM	S_0	00.00	92.44	—	—	—
	S_{20}	277.50	97.87	5.43	5002.38	4724.88
	S_{40}	555.00	101.81	9.37	8632.11	8077.11
	S_{60}	832.50	100.94	8.50	7830.62	6998.12
	S_{80}	1110.00	98.94	6.50	5988.12	4878.12
SRTI	S_0	—	61.52	—	—	—
	S_{20}	277.50	58.75	-2.77	-2551.86	-2829.36
	S_{40}	555.00	79.86	18.34	16895.72	16340.72
	S_{60}	832.50	67.58	6.06	5582.77	4750.27
	S_{80}	1110.00	64.65	3.13	2883.51	1773.51
Carew & Co.	S_0	—	61.25	—	—	—
	S_{20}	277.50	64.22	2.97	2736.11	2458.61
	S_{40}	555.00	77.68	16.43	15136.13	14586.13
	S_{60}	832.50	67.59	6.34	5840.72	5008.22
	S_{80}	1110.00	54.55	-6.7	-6172.37	-7282.37

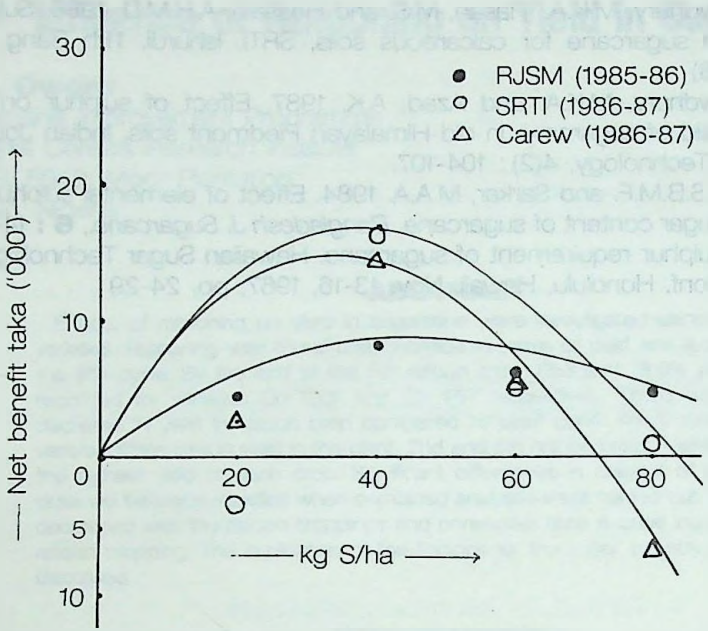

Figure 2. Economics of sulphur fertilizer.

Economics of fertilizer use :

The partial budget analysis of the marginal yield of cane were calculated and shown in the Table 4 and Figure 2. The highest net benefit was obtained with 40 kg S/ha in all locations and in general sugarcane yield as well as net benefit increased due to sulphur fertilization in all locations except use of 20 kg S/ha at SRTI location.

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