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Effect of Magnesium and Potassium on Sugarcane in Acid Soils of Bangladesh

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ABSTRACT

Both individual and combined effect of magnesium and potassium on sugarcane were investigated in a non calcareous brown floodplain soils (Typic Haplaquept) of Thakurgaon, Bangladesh during 1994-95 and 1995-96 crop seasons. The crop responded differently to magnesium application along with potassium, but in most cases potassium application significantly increased tiller, millable cane and yield of sugarcane in both the years. Combined effect of magnessium and potassium was found significant for all the yield contributing parameters like tiller, millable cane and yield of sugarcane in the second year, but it was insignificant in the first year. However, 10kg Mgha^{-1} along with 150 and 200 kg K_2Oha^{-1} produced highest cane yield of 55.7 and 61.8 t ha^{-1} in the first and second year respectively. Compared to the higher doses of 20 and 30kg Mgha^{-1}, 10kg Mgha^{-1} was found suitable for sugarcane production in the non calcareous brown floodplain soil.

Key words : magnesium, potassium, sugarcane, acids soils

INTRODUCTION

With the increasing agricultural production, considerable amount of secondary nutrients, like sulphur, calcium and magnesium are removed from the soil and widespread deficiencies have been observed. As, these nutrients are by no means of secondary importance in plant nutrition, this deserve greater attention. The status of available magnesium in the soil cane not be considered independedly, it is influenced by the contents of other cation such as calcium (Ca) and potassium (K) and by the soil acidity. Plants take magnasium in smaller quantities than potassium although the contents of exchangeable Mg in the soil and the Mg concentration of the soil solution are often higher than the corresponding values for K. There is a antagonism between K and Mg but it seems to be confined to the deficiency range of nutrient availability. Under such condition, increasing the supply of one nutrient aggravates the deficiency of other. Usually high contents of Mg can be found in plants deficient in K. Application of potash fertilizers to correct K deficiency leads to a gradual decrease of magnesium contents in the plants. When both K and Mg are deficient, it is advisable to improve the magnesium status of the soil by adequate Mg fertilizer dressings before applying heavy dose of K. Usually, soils are considered deficient in plant available magnasium when the contents of exchangeable ranged betweeen Mg 3-4mg/100g of soil (Anon., 1992).

Magnesium and potassium are of considerable significance in acid soils. Magnesium content in acid soil of Bangladesh is low (Anon. 1989). Crop response to applied magnesium have been reported either on acid soils (Tajuddin, 1991) or on sandy soil, (Aulakh and Pasricha, 1977; Kumar *et al.* 1981; Sing and Sing, 1990) which have low amount of exchangeable magnesium. Increase in sugarcane yield due to applied magnessium has been reported in Queensland, Australia (Shahjahan, 1980), British Guina (Evans, 1979), Puerto Rico (Landrau and Samuels, 1986; Bonnet, 1985) and Taiwan (Chao and Li, 1989). There is paucity of information on the effect on magnesium and potassium on the yield of sugarcane in Bangladesh. In view of this, the present study was conducted to find out both individual and combined effect of magnesium and potassium on sugarcane production.

MATERIALS AND METHODS

The experiment was conducted on a non calcareous brown floodplain soil (Typic Haplaquept) of the Old Himalayan Piedmont plain soils of North Regional Station (NRS) farm of Bangladesh Sugarcane Research Institute, Thakurgaon, Bangladesh during 1994-95 and 1995-96 crop seasons. The experiment was laid out in randomized complete block design with 4 replications maintaining a net plot size 8 m x 6m. Sugarcane variety Isd 16 was used as a test crop with three levels of magnesium (10, 20 and 30 kg Mg/ha) and two levels of potash (150 and 200 kg K_2O/ha) including one control of each. Commercial grade of magnesium oxide (45% Mg) and muriate of potash (60% K) was used as a source of Mg and K respectively.

All the plots of sugarcane were fertilized with recommended dose of N, P and S (160 kg N, 120 kg P_20_5 and 40kg Sha^{-1}) as urea, triple super phosphate and gypsum respectively. Whole amount of phosphorous, sulphaur and magnesium and 50% of urea and potash (as per treatment) were applied at the time of transplanting, the rest 50% of urea and potash were applied after completion of tillering stage. Sugarcane settling raised in a polytheline bag were transplanted in November each year and harvested in December on the following year. Weeding and mulching, gap-filling, earthing-up and mechanical control of insects and pests were done as per normal practice. Data on tiller were recorded at peak tillering stage, millable cane and yield of cane were recorded at harvest.

Soil samples (0-25cm) were collected before transplanting of sugarcane in all of the cropping seasons and later analyzed for nutrient status. Soil pH was measured in soil water suspension at 1:2.5 by glass electrode, total N by Kjeldahl method, available phosphorous was determined after extraction with 0.05 M $NaHC0_3$ at pH 8.5 following chlorostannous reduced molybdophosphoric blue colour method, exchangeable potassium was estimated flame photometrically in NH_4OAc extract and exchangeable magnesium in NaOAc extract was estimated by titrating with EDTA solution (Jackson, 1973). Available sulphur (NH_4OAc) extractable by turbidimetric method of Bradsley and Lancaster (Black, 1965). Characterstics of the initial soils are given in the Table 1.

Table 1. Characterstics of soils of experimental field.

Crop year	pH	Organic Carbon (%)	Total N (%)	Available P (ppm)	Exchangeable K (me/100g)	Avialable S (ppm)	Exchangeable Mg (me/100g)
1994-95	5.1	0.72	0.08	13.5	0.14	11.3	0.68
1995-96	5.6	0.65	0.06	12.0	0.12	13.3	0.53

RESULTS AND DISCUSSION

It is seen that magnesium application had no significant effect on tillering of sugarcane in both the year. With the increment of magnesium level number of tiller is increased, but no trend was observed However, the highest number of tiller was recorded at 10kg $Mgha^{-1}$. Tiller production increased significantly with the application of potassium compared to the control in both the year. In the first year combined effect of magnesium and potassium on tiller production was insignificant, though the highest number of tiller was found with 10kg Mg ha^{-1} applied along with 150kg K_2O ha^{-1}. Interaction of magnesium and potassium was found significant for tiller production in second year and the highest tiller was found where 200kg $K_2O ha^{-1}$ was applied (Table 2a).

Table 2a. Tiller production of sugarcane (per hectare in thousand).

Mg kg/ha	1994-95				1995-96			
	Potassium kg/ha							
	K_0	K_{150}	K_{200}	Mean	K_0	K_{150}	K_{200}	Mean
Mg_0	152.9	196.2	193.9	181.0	147.3	180.5	196.7	174.8
Mg_{10}	167.0	204.8	185.2	185.0	171.7	165.8	185.2	174.3
Mg_{20}	167.8	170.4	197.6	178.0	187.4	171.6	164.6	174.6
Mg_{30}	158.0	193.0	196.0	182.3	162.4	176.0	173.5	170.6
Mean	161.4	191.1	193.2		167.2	173.5	180.0	
			LSD (P = 0.05)			LSD (P = 0.05)		
Magnesium (Mg)			NS			NS		
Potassium (K)			15.21			4.426		
Mg x K			NS			8.852		

In both the years individual application of magnesium did not show any significant results on millable cane production compared to the control, but millable cane production significantly influenced by the application of potassium. Application of K @ 150 kg K_2O ha^{-1} produced the maximum number of millable cane (76.0 $x10^3$ ha^{-1}) in the first year, whereas in the second year 200kg K_2Oha^{-1} produced the maximum number of millable cane (78.5 x 10^3 ha^{-1}). In the first year combined effect of magnesium and potassium was insignificant, however, effect was significant in the following year (Table 2b).

Table 2b. Millable cane production (per hectare in thousand).

Mg kg/ha	1994-95				1995-96			
	Potassium (kg/ha)							
	K_0	K_{150}	K_{200}	Mean	K_0	K_{150}	K_{200}	Mean
Mg_0	58.6	67.2	68.8	64.8	58.8	72.1	78.5	69.8
Mg_{10}	60.6	76.0	62.3	66.3	68.6	66.3	73.9	69.6
Mg_{20}	62.9	64.3	66.3	64.5	73.9	68.6	65.8	69.5
Mg_{30}	59.5	70.1	65.1	64.9	64.5	71.0	69.6	68.3
Mean	60.4	69.4	65.6		66.5	69.5	72.0	
			LSD (P = 0.05)			LSD (P = 0.05)		
Magnesium (Mg)			NS			NS		
Potassium (K)			4.78			2.041		
Mg x K			NS			4.083		

Like other parameters individual effect of magnesium on the sugarcane yield was insignificant. Though the response is insignificant in both the year, magnesium application increase the yield of sugarcane compared to the control. Saha and Ghosh (1997) reported that 10kg Mg ha^{-1} produced the highest yield of cane in acid soils of Bangladesh. The highest yield of cane 55.7 and 61.8 t ha^{-1} was recorded in the first and second year when 10kg Mg was applied along with 150 and 200 kg K_2Oha^{-1}. Seemlier results was also reported by (Rahman *et al.* 1986) in the acid soil of Bangladesh and Landrau and Samuels (1986) in

Puerto Rico. Chao and Li (1989) reported that application of magnesium increased yields of sugarcane by 10 to 15% in Taiwan. Significant yield response was found with the application of potassium in the second year though it is absent in first year. However, the highest yield of cane was recorded with 150 and 200kg K_2Oha^{-1} in the first and second year respectively. Combined effect of magnesium and potassium on sugarcane yield was insignificant in the first year, but significant response of sugarcane yield due to Mg and K was found on the following year. Interaction of K and Mg showed that yield of cane was maximum with 10kg Mg ha^{-1} along with 150 and 200 kg K_2Oha^{-1} in the first and second year respectively (Table 2c). The economical analysis on the yield (average of two years) of sugarcane showed that highest net benefit was obtained with 10 kg Mg ha^{-1}, whereas higher dose of magnesium is not profitable for sugarcane production (Table 3).

Table 2c. Yield of sugarcane (ton/ha).

Mg kg/ha	1994-95				1995-96			
	Potassium kg/ha							
	K_0	K_{150}	K_{200}	Mean	K_0	K_{150}	K_{200}	Mean
Mg0	38.7	50.8	49.1	46.2	42.8	52.3	58.2	51.1
Mg10	49.8	55.7	48.0	51.2	49.7	51.0	61.8	54.2
Mg20	54.5	47.0	49.8	50.4	55.0	55.2	53.0	54.4
Mg30	41.8	50.2	49.5	47.2	48.8	58.8	57.8	55.1
Mean	44.2	50.9	49.1		49.8	54.3	57.7	
			LSD (P = 0.05)			LSD (P = 0.05)		
Magnesium (Mg)			NS			NS		
Potassium (K)			NS			3.042		
Mg x K			NS			6.084		

Table 3. Economics of magnesium fertilization on sugarcane yield (average of two years).

Mg Levels Kg/ha	Cost of Mg fertilizer (Taka)*	Yield of cane (t/ha)	Yield Increased over control (t/ha)	Net Income to Mg fertilizer (Tk/ha)	Net benefit to Mg fertilizer (Tk./ha)
0	0	48.65	-	-	-
10	2500	52.70	4.05	4050	(+) 1550
20	5000	52.40	3.75	3750	(-) 1250
30	7500	51.15	2.50	2500	(-) 5000

* Local Currency : Price of cane Tk. 1000.00 per ton, magnesium Tk. 250.00 per kg.

From the study it is evident that application of 10 kg Mg along with K @ 150 and 200kg ha^{-1} may be beneficial for sugarcane production in this acid soils which requires further verification.

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