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Effect of Fertilization on Fodder Maize (Zea Mays) in Alluvial Soil

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Abstract – An experiment was conducted in alluvial soil of Etawah with Sulphur levels (20, 40, 60 and 80 kg S/ha) and sources i.e., ammonium sulphate, pyrite, Gypsum and elemental sulphur including control indicated that the forage yield, nutrient content and their uptake of N, P, S, and Ca by maize increased upto 40 kg S/ha. Ammonium sulphate was the best source and gave highest forage yield and uptake of nutrients due to its solubility in water. The application of ammonium sulphate produced maximum forage yield than other sources.

With the intensification agriculture and the usages of sulphur free fertilizers the yields of forage crops are often reduced (Aulakh et al., 1977; Singh et al., 1979; Tripathi and Hazra, 1988). In fact, elemental sulphur only was concerned in. crop production, it is costly because imported and takes more time for its transformation in the soil into sulphate by bacteria. Most of the forages are grown for very short period (60-75 days) and require readily available source of this element. There are number of Sulphur containing materials like, gypsum and iron pyrite available in our country and are comparatively cheaper in price. But their efficacy in crop production, especially for fodder crops is yet to be fully assessed.

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MATERIALS AND METHODS

A field experiment was conducted on typic Ustochrept soil during summer seasons 2014 in alluvial soil at NCSA research farm Etawah with four treatments consisted of four levels of Sulphur i.e., 20, 40, 60 and 80 kg/ha. The sources were ammonium sulphate, pyrite, Zypsum and elemental sulphur and a control with three replications in a randomised block design. The nitrogen supplied by ammonium sulphate was accounted for. The remaining dose of N was met out partly from diammonium phosphate applied to supply 60 kg P_20/ha. The balance dose of N to supply 100 kg N/ha was also done through urea.

The well dried and ground plant samples were digested in HNO-HCIO, acid mixture (4:1) and analysed for N, P, S and Ca by microkjeldahl method, Vanado molybdophosphate acid yellow colour method (Jackson, 1973), turbidimetrically (Chesnin and Yien, 1951) and Versene titration method, respectively. The plant Zn, Fe and Cu contents were estimated by atomic absorption spectophotometry. Soil samples were also drawn before the start of the experiment and analysed for some important properties by using standard methods (Table 1).

Table 1

Physical and Chemical Properties of soil

Soil property	Value	Method (Reference)
Mechanical separate		Hydrometer method (Black, 1965)
Sand (%)	57.0	
Silt (%)	26.3	
Clay (%)	16.2	
Textural class	Sandy loam	
pH	7.9	pH meter by using soil : water in 1 : 2.5 (Jackson, 1973)
Electrical conductivity (mmhos/cm)	0.325	Soil water suspension in 1 : 5 (Jackson, 1973)
Organic carbon (%)	0.40	Walkley and Black's method (Jackson, 1973)
Extractable N (kg/ha)	192	Alkaline K MnO_4 method (Jackson, 1973)
0.5N $NaHCO_3$ extractable P (P_2O_5 kg/ha)	20	Olsen's method (Jackson, 1973)
0.15% $CaCl_2$ extractable S (ppm)	8	Turbidimetric method (Chesnin and Yien, 1951)

RESULTS AND DISCUSSION

Forage Yield

Forage yield of maize significantly increased with sulphur application upto 40 kg S/ha over control (Table 2). Further increase in dose to 60 and 80 kg S/ha did not reached upto significant increase level in fodder yield. The responses of other forage crops to S application have also Tups to been reported by Aulakh et al. (1977) and Tripathi and Hazra (1988), Tripathi et-al (1992). Ammonium sulphate had been proved best source of Sulphur followed by gypsum, pyrite and elemental sulphur. The response of ammonium sulphate might be best due to the release of adequate amount of sulphur, due to being highly water soluble, which in turn, resulted in greater herbage production. Elemental sulphur response was lowest in term of forage yield. It may be due to slow release of sulphate sulphur from it.

The interaction of sources x levels of Sulphur was significant during the years where application of Sulphur through ammonium sulphate at 40 kg S/ha produced maximum green and dry fodder yields than pyrite and elemental sulphur at 60 kg S/ha, except dry fodder yield. The functional relationship between green fodder yield and levels of different sources of S was found to be quadratic.

Table 2

Effect of Sulphur sources and levels on yield of fodder MAIZE (q/ha)

S. Source	S application (kg/ha)									
	20		40		60		80		Mean	
	Green fodder	Dry fodder	Green fodder	Dry fodder	Green fodder	Dry fodder	Green fodder	Dry fodder	Green fodder	Dry fodder
Ammonium Sulphate	359.6	81.42	389.17	84.82	386.3	84.14	383	83.56	379.52	83.47
Pyrite	345.5	78.76	360.4	82.3	373.7	84.63	371.1	82.3	362.67	82
Gypsum	359.48	80.39	386.99	84.73	382.8	79.6	379.13	82.75	376.1	82.87
Elemental S	343.53	78.59	354.13	81.95	360.83	83.52	358.83	82.75	354.33	82.82
Mean	352.03	79.79	372.67	83.45	375.9	83.98	373.01	82.84		
Control	311.2	70.55								
	Sources		Levels		Sources x Levels		Treatment V/s Control			
C.D. (5%)	4.28	0.91	4.28	0.91	8.5	1.67	8.77	1.76		

Major Nutrients Content and their Uptake

Nitrogen and Phosphorus

Data in Tables 3 reveal that, in general, nitrogen and phosphorus contents of crop plants were increased with S application as compared to control. The increase in S levels upto 40 kg/ha increased nitrogen and phosphorus content significantly. Gaur et al. (1971) an antagonistic response of P content with higher levels of S addition. Ammonium sulphate gave higher N and P content than gypsum, pyrite and elemental sulphur. The superiority of ammonium sulphate might be due to release of more sulphate ions being water soluble source than pyrite and elemental sulphur which are slightly and insoluble source in water and released less sulphate ions during oxidation process.

Secondary Nutrients Content and their Uptake Sulphur and Calcium

The Sulphur and calcium progressively increased by S fertilization over control (Tables 4 and 5). Similar results were also reported by Singh and Singh (1983) and Raikhy et-al (1985). The incremental rates of S added to crop increased S content upto 60 kg S/ha and Ca content upto 40 kg S/ha. Similar results have also been reported by Singh and Singh (1975) and Triapthi et-al (1992) in sorghum for Sulphur content and Singh (1986) for Calcium content. Ammonium sulphate and gypsum application with respect to S and Ca content, respectively were superior to other S sources. Ammonium sulphate was superior because of high soluble sulphate sulphur content. whereas the effect of gypsum was primarily due to presence of higher amount of Calcium ions. The elemental sulphur and pyrite was lowest because of slow release of sulphate ions.

The interaction effect between sources and levels was significant for both the years with respect to total plant S content. It was found that S content in plants at 40 kg S/ha through ammonium sulphate was significantly higher than at 60 kg. S/ha through elemental sulphur. The increasing levels of S increased uptake of S and Ca and the maximum was at 40 kg S/ha with ammonium sulphate for S uptake and with gypsum for Ca uptake.

The application of Sulphur with different levels and sources increases the forage yield, nutrient uptake, primary and secondary plant nutrients by the plant. The use of ammonium sulphate increase green fodder yield more than application of gypsum, pyrite and elemental sulphur.

Table 3

Effect of Sulphur sources and levels on P & S content (q/ha)

S. Source	S application (kg/ha)									
	20		40		60		80		Mean	
	P	S	P	S	P	S	P	S	P	S
Ammonium Sulphate	0.087	0.15	0.099	0.177	0.096	0.176	0.09	0.175	0.093	0.169
Pyrite	0.081	0.139	0.087	0.154	0.089	0.168	0.087	0.166	0.085	0.157
Gypsum	0.086	0.148	0.094	0.174	0.093	0.173	0.089	0.172	0.09	0.167
Elemental S	0.077	0.136	0.083	0.15	0.085	0.166	0.084	0.164	0.082	0.154
Mean	0.082	0.143	0.09	0.164	0.09	0.17	0.087	0.169		
Control	0.075	0.087								
	Sources		Levels		Sources x Levels		Treatment V/s Control			
C.D. (5%)	0.004	0.005	0.004	0.005	0.006	0.008	0.007	0.009		

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