

Original Research Article

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Influence of Different Sulphur Sources at Various Levels on Growth and Yield of Green Gram in Alfisol of Madurai District, Tamil Nadu, India

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ABSTRACT

A field experiment was conducted to evaluate the influence of different sulphur sources at various levels on growth and grain yield of green gram in Alfisol of Madurai district, Tamil Nadu during kharif season in the year 2018. Four sources [Ammonium sulphate (S₁), Potassium sulphate (S₂), Magnesium sulphate (S₃) and Calcium sulphate (S₄)] at four different levels [0 (L₁), 20(L₂), 40(L₃), 60 (L₄) kg ha⁻¹] applied along with recommended source of fertilizer (RDF) were designed for the study. The experiment was replicated thrice following factorial randomized block design (FRBD). The results showed that the combined effect of RDF with calcium sulphate at the level of 40 kg ha⁻¹ had a considerable enhancement of crop growth, yield attributes and yield of green gram in Alfisol. Among the different treatment combinations, the highest and appreciable crop growth, yield attributes and maximum grain yield of 1297 kg ha⁻¹ green gram was recorded in the combined treatment, L₃S₄ (calcium sulphate at 40 kg ha⁻¹+RDF) and the lowest values of all parameters were observed in the control (L₁).

Keywords

Sulphur sources,
Sulphur levels,
Green gram, Yield

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Introduction

Pulses are important not only for their value as human food, but also because of high protein content for livestock. It has been important component of Indian agriculture enabling the land to restore fertility by fixing atmospheric

nitrogen, so as to produce reasonable yields of succeeding crops and to meet out the demand of dietary requirement regarding proteins, carbohydrates and other nutrient sources. Green gram (*Vigna radiate* L. Wilczek) is commonly known as 'mung' or 'mungbean', which is the most important crop throughout

South-East Asia and particularly in the Indian sub-continent. It is the third important pulse crop which was sown over an area of 4.26 Mha in (kharif + rabi) and recorded a production of 2.01 Mt at and yield level of 472 kg/ha (Anonymous, 2018).

It is grown mainly as kharif crop in Rajasthan, Maharashtra, Karnataka, Andhra Pradesh, Orissa, Tamil Nadu, whereas in rabi/spring it is grown in Tamil Nadu, Bihar, Orissa, Andhra Pradesh, Uttar Pradesh, West Bengal, Maharashtra and Karnataka.

In summer season it is grown in Uttar Pradesh, Madhya Pradesh, Bihar, Jharkhand and Orissa states. It is highly digestible and free from the flatulent effects unlike other pulses.

The greengram foliage left over after picking of mature pods can either be fed to livestock or it may ploughed in the field as a green manure to enrich soil with organic matter. Mungbean is a very short duration crop so it can be grown as catch crop. Sulphur enhances crop yield and produce quality of pulses. The present investigation was undertaken to study the influence of sulphur sources at different levels on growth and yield of green gram crop.

Fertilizer is an important factor which enhances the agricultural production. Sulphur is a fourth major nutrient next to nitrogen, phosphorus and potassium. The effect of Sulphur has a synergistic effect on productivity of crops (Patel *et al.*, 2010).

Sulphur is important for production of protein, vitamins and sulphur containing amino acids *viz.*, methionine, cystine and cysteine. Next to phosphorus, sulphur nutrition has been noticed to be key limiting factor in green gram production. Sulphur can be applied to the soil through any of the suitable sulphur sources, but the choice depends on crop, local availability, price and need for other nutrients.

Materials and Methods

Field experiment was conducted at Lalapuram village, Kalligudi block of Madurai district, Tamil Nadu during the Kharif season in the year 2018. The experimental field's soil texture was sandy loam in nature, belonged to one of the major soil order (Alfisol) in Madurai district. The pH of the soil was 7.25 and EC of 0.12 d Sm^{-1} . The soil was low in organic carbon with 0.19 % and low in available sulphur status with a value of 4.80 mg kg^{-1} . The statistical design followed to conduct a field experiment was randomized block design with factorial concept. The treatment comprised of four different sulphur sources [Ammonium sulphate (S_1), Potassium sulphate (S_2), Magnesium sulphate (S_3) and Calcium sulphate (S_4)] at four various levels [$0 (L_1)$, $20(L_2)$, $40(L_3)$, $60 (L_4) \text{ kg ha}^{-1}$] with three replications. These were applied along with RDF of $25 \text{ kg N} + 50 \text{ kg P}_2\text{O}_5 + 25 \text{ kg K}_2\text{O}$ for irrigated green gram. Here, the treatment $L_1 (0 \text{ kg S ha}^{-1} + \text{RDF})$ mean value of all parameters of green gram was taken as control and it was taken for comparison with effect of individual levels, individual sources and for treatment combinations.

Results and Discussion

The results derived from the present study are presented in the following:

Effect of sulphur sources on green gram

Different sources of sulphur application considerably increases the crop growth, yield attributes *viz.*, plant height, number of branches per plant, number of pods per plant, number of seeds per pod, 100 seed weight and grain yield. These attributes were increased by the application of calcium sulphate than other sulphur sources. The increase in grain yield of 1018 kg ha^{-1} and haulm yield of 1472 kg ha^{-1} (Table 4) was observed in the experimental

plot where calcium sulphate (gypsum) was applied as sulphur source. The increase in grain yield was about 21 per cent over control. This increase in grain yield might be due to the release of readily available SO_4 in the gypsum as compared to other sources. This also might be due to mobility of sulphur for the crop growth and one more reason might be due to application of gypsum attributes a considerable improvement in the soil physico-chemical properties which also helps the soil to maintain a good soil structure. These results were in conformity with the findings of Dwivedi *et al.*, (1996).

Effect of sulphur levels on green gram

The research findings revealed that influence of sulphur levels showed a noticeable crop growth, yield attributes and yield of green gram. The increase in yield attributes was maximum when the sulphur level was applied upto 40 kg ha^{-1} . After which, the growth, yield attributes and yield decreases, (i.e.), when the sulphur level was applied upto 60 kg ha^{-1} . Application of 40 kg S ha^{-1} enhanced the growth and yield parameters appreciably. The highest grain yield of 1209 kg ha^{-1} and highest haulm yield of 1827 kg ha^{-1} was observed in the sulphur level at 40 kg S ha^{-1} . The lowest grain yield (804 kg ha^{-1}) and haulm yield (994 kg ha^{-1}) was noticed in the without sulphur applied plot (Table 4). The maximum grain yield at the rate of 40 kg ha^{-1} might be due to vital role of sulphur in maintaining the enzymetic and metabolic processes involving respiration, photosynthesis and activation of energy transformation which had reflected in highest grain yield. This was also might be due to increasing the status of available sulphur in soil and making it to reach a sufficient sulphur level which further, helps in bold seeds and filled pods which in turn enhanced the grain yield of green gram. These results were

similar to the findings stated by Singh and Agarwal (1998) and Ghosh and Sarkar (2000).

Effect of treatment combination on green gram

Between the treatment combinations, sulphur application through calcium sulphate at 40 kg ha^{-1} showed a maximum plant height at 30 DAS, 45 DAS and at harvest were 25.5, 38.5 and 43.9 cm respectively (Table 1). Root length of 14.5 cm (Table 2), yield attributes *viz.*, number of pods plant^{-1} of 17.0, number of seeds pod^{-1} of 10.77 and 100 seed weight of 4.00 and grain yield of 1297 kg ha^{-1} (Table 3 and 4) were registered maximum in treatment plot where calcium sulphate at 40 kg ha^{-1} was applied as sulphur source with recommended dose of fertilizer (L_3S_4) in Alfisol soil order for green gram crop which was followed by the treatment combination L_3S_1 (40 kg S ha^{-1} as ammonium sulphate + RDF) and root length of 7.3 cm , yield attributes *viz.*, number of pods plant^{-1} of 8.7, number of seeds pod^{-1} of 5.45 and 100 seed weight of 2.51 and grain yield of 804 kg ha^{-1} was found minimum in sulphur unapplied plot (L_1). These results gained owing to the process of cell or tissue differentiation from somatic to reproductive meristematic activity and enlargement of floral primordial might have enhanced with the application of sulphur levels upto 40 kg S ha^{-1} resulting in more number of flowers and longer pods and higher grains yield. Similar findings were reported by Saini and Rajesh Singh (2017).

Among the different treatment combinations, the highest and appreciable crop growth, yield attributes and grain yield of green gram was recorded in the experimental plot where the calcium sulphate at 40 kg ha^{-1} along with RDF (L_3S_4) was applied as sulphur source and the lowest values of those parameters were observed in the control (L_1).

Table.1 Effect of different sulphur sources at various levels on plant height (cm) of green gram

Sulphur levels	Plant height (cm)														
	30 DAS					60 DAS					At harvest				
	Sulphur sources					Sulphur sources					Sulphur sources				
	S ₁	S ₂	S ₃	S ₄	Mean	S ₁	S ₂	S ₃	S ₄	Mean	S ₁	S ₂	S ₃	S ₄	Mean
L ₁	16.0	15.8	15.5	15.7	15.8	19.4	19.3	19.1	19.1	19.3	25.7	25.2	25.4	25.1	25.4
L ₂	19.7	19.0	18.4	20.0	19.3	30.4	28.7	27.2	31.8	29.5	37.5	35.6	33.7	39.2	36.5
L ₃	24.0	22.0	21.0	25.5	23.1	36.7	35.1	33.3	38.5	35.9	44.7	43.0	41.1	46.8	43.9
L ₄	17.7	17.2	16.6	18.0	17.4	23.9	22.5	20.9	25.6	23.2	30.3	28.7	26.9	32.0	29.5
Mean	19.3	18.5	17.7	19.8		27.6	26.4	25.1	28.8		34.5	33.1	31.8	35.8	
	L	S	L x S			L	S	L x S			L	S	L x S		
SEd	0.20	0.20	0.40			0.25	0.25	0.50			0.37	0.37	0.74		
CD (P=0.05)	0.42	0.42	0.83			0.52	0.52	1.03			0.76	0.76	1.51		

Table.2 Effect of different sulphur sources at various levels on root length (cm) of green gram

Sulphur levels	Root length (cm) at harvest				
	Sulphur sources				
	S ₁	S ₂	S ₃	S ₄	Mean
L ₁	7.3	7.3	7.2	7.2	7.3
L ₂	11.5	11.0	10.4	12.1	11.3
L ₃	13.8	13.2	12.7	14.5	13.6
L ₄	8.9	8.3	7.7	9.6	8.61
Mean	10.4	10.0	9.5	10.9	
	L	S	L x S		
SEd	0.08	0.08	0.16		
CD (P=0.05)	0.17	0.17	0.33		

Table.3 Effect of different sulphur sources at various levels on yield attributes of green gram

Sulphur levels	yield attributes														
	No. of Pods plant ⁻¹					No. of seeds pod ⁻¹					100 Seed weight (g)				
	Sulphur sources					Sulphur sources					Sulphur sources				
	S ₁	S ₂	S ₃	S ₄	Mean	S ₁	S ₂	S ₃	S ₄	Mean	S ₁	S ₂	S ₃	S ₄	Mean
L ₁	8.8	8.7	8.7	8.7	8.7	5.48	5.46	5.41	5.43	5.55	2.53	2.52	2.50	2.50	2.51
L ₂	13.2	12.4	11.7	14.0	12.8	8.45	7.95	7.44	7.01	7.71	3.30	3.13	3.09	3.36	3.22
L ₃	16.2	15.4	14.7	17.0	15.8	10.26	9.77	9.32	10.77	10.03	3.81	3.67	3.52	4.00	3.75
L ₄	10.3	9.5	9.4	11.0	10.0	6.53	6.15	6.02	9.50	7.05	2.89	2.73	2.68	2.94	2.81
Mean	12.1	11.5	11.1	12.7		7.68	7.33	7.05	8.18		3.13	3.01	2.95	3.20	
	L	S	L x S			L	S	L x S			L	S	L x S		
SEd	0.14	0.14	0.28			0.06	0.06	0.13			0.03	0.03	0.06		
CD (P=0.05)	0.29	0.29	0.58			0.13	0.13	0.26			0.06	0.06	0.11		

Table.4 Effect of different sulphur sources at various levels on yield of green gram

Sulphur levels	Grain yield (kg ha ⁻¹)					Haulm yield (kg ha ⁻¹)				
	Sulphur sources					Sulphur sources				
	S ₁	S ₂	S ₃	S ₄	Mean	S ₁	S ₂	S ₃	S ₄	Mean
L ₁	806	804	801	803	804	998	995	990	992	994
L ₂	1035	987	946	1078	1011	1536	1466	1383	1626	1503
L ₃	1236	1180	1122	1297	1209	1863	1786	1702	1957	1827
L ₄	883	847	841	895	867	1226	1134	1063	1314	1184
Mean	990	955	927	1018		1406	1345	1285	1472	
	L	S	L x S			L	S	L x S		
SEd	11.8	11.8	23.6			14.1	14.1	28.2		
CD (P=0.05)	24.1	24.1	48.1			28.8	28.8	57.7		

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