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Influence of Sulphur on Growth, Yield and Quality Attributes of Irrigated Blackgram (*Vigna mungo)* in Alfisols of Thoothukudi District in Tamil Nadu

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Field experiment was conducted at Agricultural College and Research Institute, Killikulam, Thoothukudi district of Tamil Nadu during Rabi season (Oct-Feb) 2004-2005 to assess the effect of different sources of sulphur viz., Single Super Phosphate, Gypsum, Elemental sulphur and Magnesium Sulphate on growth, yield and quality of blackgram (CO-5). The results indicated that the application of 20 kg sulphur as gypsum significantly increased the growth attributes and yield attributes of blackgram. Application of sulphur as gypsum along with N and P increase the quality attributes such as protein and amino acids like methionine and cysteine.

Key words: Blackgram, Sulphur Sources, Gypsum, Growth, Yield and Quality

The importance of sulphur has been well recognized in recent years, because of its widespread deficiency which is nearly 20-30 per cent in cultivable area of our country and extending widely in soil and crop (Tandon, 1991). In Tamil Nadu, Coimbatore and South Arcot districts are having higher sulphur deficiency. Sulphur deficiency is known to reduce the crop yield upto 35 per cent even without expressing visual symptom on plant (Pal and Singh, 1992). As an over all assessment for the tropical region, sulphur requirement per tonne yield production has been reported as 8 kg for legumes and 12 kg for oil seeds as documented by Tomar *et al*. (2000). Unfortunately our Indian farmers are using only N, P, K fertilizers and that too in imbalance proportion. Now sulphur is recognized as the fourth major plant nutrient. Along with N, P and K, S performs many important functions in the plant and plays an important role in improving yield and quality of pulses. Sulphur is also known to promote nodulation in legumes, thereby enhancing the N fixation. It is a constituent of free amino acids such as methionine and cysteine (Amruthalakshmi Devi and Pillai, 2000) and plays a vital role in protein synthesis. The requirement of pulse is fast increasing due to alarming increase in the population. This demographic compulsion and declining per capita availability of land attract attention to bridge the widening gap between demand and supply, through multipronged scientific advances in pulse production technologies. Fertilizers and manures are the kingpins in any strategy for achieving the twin objective of enhanced productivity and assured sustainability (Srinivasan, 1996). Hence the present investigation was undertaken to assess the effect of different sources of sulphur on growth, yield and quality attributes of blackgram.

Materials and Method

Field experiment was conducted at AC & RI, Killikulam, Thoothukudi district of Tamil Nadu, with blackgram (Var. CO. 5) as a test crop during Oct-Feb of 2004-2005 under irrigated condition. The experimental soil was sandy clay loam in texture; fertility status of the soil was classified

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as neutral in reaction (pH 7.3), low in available nitrogen (115 kg ha^{-1}), medium in phosphorus (14 kg ha^{-1}) and potassium (230 kg ha^{-1}). The sulphur content of the soil was 4 ppm, below the critical value of 10 ppm. The trial was laid out in RBD with three replications. A uniform dose of 25:50:0:20 kg ha^{-1} of N, P, K and S were applied for blackgram. N and P were applied in form of urea and single super phosphate respectively and sulphur was applied in the form of various sources viz., elemental sulphur (85 % S), gypsum (18 % S), single super phosphate (14 % S) and magnesium sulphate (14 % S) Zinc sulphate was given as foliar spray on 30 and 45 DAS. The crop was sown at a spacing of 30 X 10 cm. The N content of grain samples were analyzed by Microkjeldahl method (Humphries, 1956) and protein content was calculated by multiplying the total nitrogen content in grain with the factor 6.25 (Sadasivam and Manickam, 1992). Sulphur containing amino acids like methionine and cysteine were estimated by the colorimetric method (Horn *et al.,* 1946).

Results and Discussion

Growth Attributes

Root nodules and root volume

Table 1 shows that the application of gypsum favorably increased the root nodules (34.80) and root volume (6.53 cc). This might be due to the sulphur involved in the production of nitrogenase enzyme which is the key factor for increasing the rhizobial infection sites and fixation of nitrogen. Which is favoured by the application of sulphur through gypsum (Khandkar *et al.*, 1985). Significant response on the root volume could be attributed to the positive influence of sulphur nutrient through gypsum on the formation, multiplication and elongation of root cells which could have resulted in proliferation of voluminous root system in blackgram.

Dry matter production

The attributing reason for higher dry matter production (3856 kg ha^{-1}) might be due to the over all impact of sulphur on growth as well as on the yield attributes of blackgram(Table 1).

Table 1. Effect of different sources of sulphur on growth attributes and root nodules of blackgram

Treatments	Plant height (cm)	Clusters number $plant^{-1}$	Nodules $plant^{-1}$	Root volume (cc)	Dry matter (kg ha^{-1})
T_1 - Control (Recommended dose of NPK without S)	27. 5	4. 6	29. 1	3. 2	2833
T_2 - Zinc Sulphate @ 25 kg ha^{-1}	33. 1	6. 6	33. 5	5. 2	3589
T_3 - 20 kg S (Single Super Phosphate @ 165 kg ha^{-1})	32. 1	5. 3	33. 4	4. 6	3533
T_4 - 20 kg sulphur (Gypsum @ 110 kg ha^{-1})	35. 3	8. 6	34. 8	6. 5	3856
T_5 - 20 kg sulphur (Magnesium Sulphate @ 145 kg ha^{-1})	32. 6	6. 6	32. 6	4. 8	3578
T_6 - 20 kg sulphur (Elemental Sulphur @ 25 kg ha^{-1})	31. 6	5. 6	32. 5	3. 7	3289
T_7 - 0.5 % Zinc Sulphate	30. 7	5. 3	29. 4	3. 2	3133
T_8 - 1.0 % Zinc Sulphate	31. 6	5. 6	29. 7	3. 5	3156
SEd	0. 6	0. 5	0. 2	0. 1	123
CD (P=0.05)	1. 2	1. 0	0. 4	0. 2	256

Table 2. Effects of sources of sulphur on yield attributes and yield of blackgram

Treatments	Pods plant^{-1}	Pod length (cm)	Number of seeds pod^{-1}	100 Seed weight (g)	Grain yield (kg ha^{-1})
T_1 - Control (Recommended dose of NPK without S)	17. 7	3. 7	5. 0	4. 13	784
T_2 - Zinc Sulphate @ 25 kg ha^{-1}	22. 0	5. 0	6. 2	4. 67	1061
T_3 - 20 kg S (Single Super Phosphate @ 165 kg ha^{-1})	21. 3	4. 2	5. 8	4. 40	873
T_4 - 20 kg sulphur (Gypsum @ 110 kg ha^{-1})	22. 7	5. 0	6. 5	4. 73	1094
T_5 - 20 kg sulphur (Magnesium Sulphate @ 145 kg ha^{-1})	22. 3	4. 4	5. 7	4. 57	898
T_6 - 20 kg sulphur (Elemental Sulphur @ 25 kg ha^{-1})	18. 7	4. 2	5. 8	4. 53	949
T_7 - 0.5 % Zinc Sulphate	18. 3	3. 5	5. 4	4. 37	810
T_8 - 1.0 % Zinc Sulphate	18. 3	4. 2	5. 5	4. 43	817
SEd	0. 44	0. 1	0. 04	0. 06	42
CD (P=0.05)	0. 93	0. 2	0. 08	0. 12	97

Sulphur contributed for higher plant height, more number of clusters, more number of root nodules, root volume and yield attributes resulted in better development of plants resulting in increased total dry matter production. The increased root volume of the plant could have foraged widely and enabling more uptake of nutrients leading to more accumulation of dry matter production (Shinde and Saraf, 1994).

Yield attributes

Application of gypsum recorded significantly higher number of pods plant^{-1}(22.77), pod length (5.10 cm), seeds pod^{-1} (6.77) and 100 seed weight (4.88 g) could be attributed to the presence of sulphate sulphur in gypsum which is readily and easily taken up by plant for its metabolic process(Table 2). Similar views were expressed by Tandon (1999). Another reason which can be attributed is the translocation of more photosynthates from source to sink might be resulted in the positive increase of yield attributes. Control recorded the least pods/plant, pod length, number of seeds/pod and 100 seed weight. The result had concurrence with findings of Singh *et al*. (1994).

Progressive increase in yield due to the gypsum application, might be attributed to the cumulative effect of yield attributes and root volume coupled with higher nutrients uptake, more photosynthates which could have translated effectively to grain, thereby increasing the grain yield (1109 kg ha^{-1}). All attributes which were favourably influenced by sulphur sources would have directly contributed for the ultimate increase in grain yield. Among the different sources of sulphur gypsum recorded the highest

Table 3. Effect of different sources of sulphur on quality of blackgram

Treatments	Protein (%)	(mg / 100 mg of protein)	
		Methionine	Cysteine
T_1 - Control (Recommended dose of NPK without S)	18. 9	1. 6	2. 0
T_2 - Zinc Sulphate @ 25 kg ha^{-1}	23. 6	2. 6	3. 2
T_3 - 20 kg S (Single Super Phosphate @ 165 kg ha^{-1})	23. 2	2. 0	2. 6
T_4 - 20 kg sulphur (Gypsum @ 110 kg ha^{-1})	24. 0	2. 8	3. 5
T_5 - 20 kg sulphur (Magnesium Sulphate @ 145 kg ha^{-1})	22. 7	2. 1	2. 6
T_6 - 20 kg sulphur (Elemental Sulphur @ 25 kg ha^{-1})	22. 7	1. 9	2. 6
T_7 - 0.5 per cent Zinc Sulphate	22. 2	1. 7	2.5
T_8 - 1.0 per cent Zinc Sulphate	19. 9	1. 8	2. 1
SEd	0. 9	0. 1	0. 1
CD (P=0.05)	1. 9	0. 2	0. 2

stover yield of 3070 kg ha^{-1}. The favourable effect of gypsum on the nodulation resulted in more fixation and nutrient uptake which pronounced good vegetative growth contributed for the increased stover yield. The results of these findings are in line with the findings of Singh and Ram (1990). Influence of bhusa yield 485.70 kg ha^{-1} by gypsum application might be due to important role played by sulphur in the energy transformation, activation of enzyme and also in carbohydrate metabolism resulted in an increase in yield attributes viz. pod $plant^{-1}$, pod length (cm). The results are in close conformity with the findings of Arunachalam *et al*. (1995).

Quality parameters

Application of 20 kg sulphur as gypsum @ 110 kg ha^{-1} synthesized more protein and accounted as 24.48 per cent (Table 3). Among the different sources, application of 20 kg sulphur as gypsum @ 110 kg ha^{-1} was found to accumulate more methionine and cysteine 2.43 mg/100 mg of protein and 3.43 mg/100 mg of protein respectively. Enhancement in the protein content may be due to sulphur which plays a vital role in nodulation and amino acid synthesis especially sulphur containing amino acids (methionine, cysteine and cystine) and finally entered into protein structure. The enhancement in the amino acid status might be influenced by uptake and mobilization of sulphur nutrients and induced the enzyme activities during biosynthesis of sulphur containing amino acids (Singh *et al*., 2002).

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