

Effect of sulphur supplementation on growth and yield of blackgram in Typic Rhodustalf

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ABSTRACT

The effect of soil and foliar application of sulphur was investigated on blackgram in Typic Rhodustalf of pulses growing areas of Madurai district. The field experiment was laid out in a randomised block design with recommended doses of fertiliser with two levels of different sulphur sources as gypsum, ammonium sulphate and potassium sulphate which were supplied through soil and foliar application. The growth and yield components of blackgram were significantly increased viz plant height (54.7 cm), number of leaves per plant (53), number of pods per plant (35), number of seeds per pod (7), 100-grain weight (4.81 g), dry matter production (2832 kg/ha), grain yield (1145 kg/ha) and haulm yield (1645 kg/ha). Among the treatments application of 100 per cent recommended dose of fertiliser (RDF) with potassium sulphate 20 kg/ha plus foliar spray of 0.5 per cent K_2SO_4 increased the growth and yield components of blackgram.

Keywords: Sulphur; blackgram; Typic Rhodustalf

INTRODUCTION

Sulphur is the important nutrient in balanced nutrition of crops to meet the complete nutrient requirement for growing demands of food and nutrition. The transformation of sulphur element affects its plant availability. In India red and lateritic soils cover a large area and these soils are derived from granite, gneiss, schist and sand stone. However these soils are well drained and acidic with lower cation exchange capacity and organic matter content and have mixed or kaolintic clay mineralogy

enriched with sesquioxides and often deficient in S. Furthermore there is a continual push for more intensive farming and high yields that draw heavily on soil sulphur reserves. Soils of the arid and semi-arid regions have low total reserves of sulphur because of low organic matter content and its rapid mineralisation results in leaching losses of sulphur. Light textured soils suffer most from the problem of S deficiency. Low S level in Indian soils is the main reason for low yield of cereals, pulses, oilseeds and commercial crops due to its involvement in the assimilation of

nitrogen, photosynthesis, synthesis of proteins and S containing amino acids. The widespread S deficiency in Indian soils depends more on climate, vegetation, parent material, soil texture and management practices. Singh and Aggarwal (1998) found that among the sources of sulphur gypsum produced significantly higher pods per plant and seeds per pod of black gram. Singh et al (1999) reported that potassium sulphate was significantly better than elemental sulphur and pyrite but remained on par with gypsum in production of pods per plant and seeds per pod of lentil. Among the sources sulphur applied in the form of gypsum was found superior to pyrite in lentil. Jawahar et al (2013) reported that the highest plant height, leaf area index (LAI), chlorophyll content, dry mass produced (DMP) and number of branches per plant were noticed in blackgram under gypsum. The present study was undertaken to study the optimization of sulphur sources for blackgram in Madurai district soils.

MATERIAL and METHODS

A field experiment was conducted at farmer's field in Thenamallur village, Kallikudi block, Madurai district during 2014 to evaluate the effect of sulphur supplementation for growth and yield of blackgram (Vamban 4) in Typic Rhodustalf. The experimental site is located at 9° 41' 17.6" N latitude and 77° 55' 50.6" E longitude at an elevation of 127 amsl. The soil of the experimental site belonged to

Vylogam series and according to USDA soil taxonomy it could be classified as sandy clay loam fine loamy mixed isohyperthermic Typic Rhodustalf. The characteristics of the soil at experimental site were determined by standard methods and are presented in Table 1. The recommended doses of nutrients for blackgram viz 25, 50 and 25 kg/ha N, P_2O_5 and K_2O respectively were applied. The field experiment was laid out in randomized block design (RBD) replicated thrice with combination of recommended doses of fertilisers with two levels of three sulphur sources such as gypsum, potassium sulphate and ammonium sulphate for soil application (SA) and foliar spray of 0.5 per cent K_2SO_4 in 14 treatments viz T_1 (100% recommended doses of fertilisers (RDF), T_2 (T_1 + gypsum as S 10 kg/ha (SA), T_3 (T_2 + foliar spray of 0.5% K_2SO_4 at 30 and 45 DAS), T_4 (T_1 + gypsum as S 20 kg/ha (SA), T_5 (T_4 + foliar spray of 0.5% K_2SO_4 at 30 and 45 DAS), T_6 (T_1 + potassium sulphate as S 10 kg/ha (SA), T_7 (T_6 + foliar spray of 0.5% K_2SO_4 at 30 and 45 DAS), T_8 (T_1 + potassium sulphate as S 20 kg/ha (SA), T_9 (T_8 + foliar spray of 0.5% K_2SO_4 at 30 and 45 DAS), T_{10} (T_1 + ammonium sulphate as S 10 kg/ha (SA), T_{11} (T_{10} + foliar spray of 0.5% K_2SO_4 at 30 and 45 DAS), T_{12} (T_1 + ammonium sulphate as S 20 kg/ha (SA), T_{13} (T_{12} + foliar spray of 0.5% K_2SO_4 at 30 and 45 DAS), T_{14} (T_1 + foliar spray of 0.5% K_2SO_4 at 30 and 45 DAS). The dry matter production (DMP) was recorded from the

net plot area at harvest stage; the collected plants were shade-dried and oven-dried at 65°C until a constant weight reached. Number of pods in each sample plant was counted and the mean number of pods per plant was recorded. Number of seeds per pod was recorded from ten pods selected at random in each plot. The average number of seeds per pod was recorded. Harvesting was done from net plot area leaving two border rows all around. Well mature blackgram plants were pulled out and sundried for two days. Threshing was done by beating with sticks. Grain yield was recorded plot-wise at 14 per cent moisture level. The dry weight of haulm yield from each plot was recorded. The experimental data were analysed as per the procedure outlined by Gomez and Gomez (1984).

RESULTS and DISCUSSION

Experimental site

The soil of the experimental site was neutral in pH (7.17), non-saline EC (0.43 dS/m), low in $\text{KMnO}_4\text{-N}$ (234 kg/ha), high in Olsen-P (24.8 kg/ha), medium in $\text{NH}_4\text{OAc-K}$ (244 kg/ha), deficient in CaCl_2 extractable S (9.9 mg/kg) and medium in organic carbon (5.43 g/kg). The micronutrient status of the experimental site was deficient in diethylenetriamine pentaacetic acid (DTPA) extractable Zn (0.92 mg/kg), sufficient in DTPA extractable Fe (9.10 mg/kg), moderate in DTPA extractable Cu (1.64 mg/kg)

and high in DTPA extractable Mn (34.8 mg/kg) (Table 1).

Effect of sulphur on growth components

Soil and foliar application of sulphur influenced growth components viz plant height, number of leaves per plant and dry matter production of blackgram in Typic Rhodustalf (Table 2). Among the sulphur sources soil application of 100 per cent RDF with potassium sulphate @ 20 kg/ha plus foliar spray of 0.5 per cent $\text{K}_2\text{SO}_4(\text{T}_9)$ recorded higher plant height (54.7 cm), number of leaves per plant (55) and dry matter production (2832 kg/ha). The present results show that application of sulphur 20 kg/ha applied through soil application and foliar spraying of 0.5 per cent $\text{K}_2\text{SO}_4(\text{T}_9)$ significantly influenced the growth of blackgram. Increased growth components observed under gypsum might be attributed to readily available sulphate form of S and enhanced uptake of nutrients even at the initial stage of crop growth. Similar findings were reported by Kandpal and Chardel (1993) and Sing et al (1994). Mir et al (2013) reported that the sulphur 40 kg/ha significantly increased the plant height (39.59%), number of leaves per plant (15.86), grain yield q/ha (13.46%) and haulm yield (10.93%) of blackgram as compared to no sulphur application. Ammonium sulphate was a better S source than gypsum regarding its effect on seed yield of (Islam et al 2012). The results are also supported by the findings of Singh et al (1999).

Table 1. Initial physico-chemical properties of the soil of the experimental site

Parameter	Character/value
Textural class	Sandy clay loam
Soil reaction (pH)	7.17
EC (dS/m)	0.43
CEC (c mol (p ⁺)/kg)	12.3
AEC (c mol _c /kg)	4.2
Total sesquioxides (%)	12.6
Organic carbon (g/kg)	5.43
Alk - KMnO ₄ - N (kg/ha)	234
Olsen - P (kg/ha)	24.8
NH ₄ OAc - K (kg/ha)	244
CaCl ₂ - S (mg/kg)	9.9
Exchangeable Ca (c mol (p ⁺)/kg)	7.8
Exchangeable Mg (c mol (p ⁺)/kg)	2.92
DTPA extractable Zn (mg/kg)	0.92
DTPA extractable Fe (mg/kg)	9.10
DTPA extractable Cu (mg/kg)	1.64
DTPA extractable Mn (mg/kg)	34.8

Effect of sulphur on yield components

Yield components such as grain and haulm yield of blackgram were significantly influenced by sources and levels of sulphur (Table 3). Among the different S sources 100 per cent RDF with potassium sulphate @ 20 kg/ha (SA) plus foliar spray of K₂SO₄ at 0.5% (T₉) resulted in higher grain yield (1145 kg/ha), haulm yield (1645 kg/ha), number of pods per plant (35), number of seeds per pod (7) and 100-seed weight (4.80 g) followed by ammonium sulphate and gypsum sulphate.

The 100 per cent recommended dose of fertilizers with potassium sulphate 20 kg/ha plus foliar spray of 0.5 per cent K₂SO₄ recorded higher yield components which could be due to steady release of available S and higher uptake of S which ultimately led to effective assimilate partitioning of photosynthates from source to sink in post-flowering stage and resulted in highest grain and haulm yield. These findings are supported by the work of Yadav et al (1996). Similarly Deshbhratar et al (2010) found the significant increase in

Sulphur effect on blackgram in Typic Rhodustalf

Table 2. Effect of sulphur application on growth components of blackgram in Typic Rhodustalf

Treatment	Plant height (cm)	# leaves /plant	Dry matter production (kg/ha)
T ₁	45.4	37	1820
T ₂	45.9	43	1984
T ₃	46.3	45	2020
T ₄	46.4	46	2068
T ₅	47.2	46	2178
T ₆	52.3	49	2456
T ₇	53.2	51	2518
T ₈	54.6	53	2739
T ₉	54.7	55	2832
T ₁₀	47.3	47	2375
T ₁₁	47.5	48	2462
T ₁₂	47.7	49	2534
T ₁₃	51.7	49	2586
T ₁₄	45.3	40	1855
Mean	48.9	47	2319
SEd	1.02	1.2	41.02
CD _{0.05}	2.09	2.4	84.32

T₁ (100% recommended doses of fertilisers (RDF), T₂ (T₁ + gypsum as S 10 kg/ha (SA), T₃ (T₂ + foliar spray of 0.5% K₂SO₄ at 30 and 45 DAS), T₄ (T₁ + gypsum as S 20 kg/ha (SA), T₅ (T₄ + foliar spray of 0.5% K₂SO₄ at 30 and 45 DAS), T₆ (T₁ + potassium sulphate as S 10 kg/ha (SA), T₇ (T₆ + foliar spray of 0.5% K₂SO₄ at 30 and 45 DAS), T₈ (T₁ + potassium sulphate as S 20 kg/ha (SA), T₉ (T₈ + foliar spray of 0.5% K₂SO₄ at 30 and 45 DAS), T₁₀ (T₁ + ammonium sulphate as S 10 kg/ha (SA), T₁₁ (T₁₀ + foliar spray of 0.5% K₂SO₄ at 30 and 45 DAS), T₁₂ (T₁ + ammonium sulphate as S 20 kg/ha (SA), T₁₃ (T₁₂ + foliar spray of 0.5% K₂SO₄ at 30 and 45 DAS), T₁₄ (T₁ + foliar spray of 0.5% K₂SO₄ at 30 and 45 DAS)

Table 3. Effect of sulphur application on yield components on blackgram of Typic Rhodustalf

Treatment	Grain yield (kg/ha)	Haulm yield (kg/ha)	# pods/ plant	# seeds /pod	100-grain weight (g)
T ₁	807	982	25	5	4.75
T ₂	858	1089	27	5	4.76
T ₃	879	1107	28	5	4.76
T ₄	899	1132	28	6	4.77
T ₅	921	1221	29	6	4.78
T ₆	1049	1332	31	5	4.78
T ₇	1098	1411	33	6	4.79
T ₈	1101	1598	33	7	4.79
T ₉	1145	1645	35	7	4.80
T ₁₀	945	1288	27	5	4.79
T ₁₁	953	1394	29	5	4.80
T ₁₂	986	1476	31	6	4.80
T ₁₃	999	1520	32	6	4.81
T ₁₄	825	1012	26	5	4.76
Mean	962	1301	30	6	4.78
SEd	23.4	35.8	1.45	0.8	NS
CD _{0.05}	48.0	73.5	2.99	1.6	NS

T₁ (100% recommended doses of fertilisers (RDF), T₂ (T₁ + gypsum as S 10 kg/ha (SA), T₃ (T₂ + foliar spray of 0.5% K₂SO₄ at 30 and 45 DAS), T₄ (T₁ + gypsum as S 20 kg/ha (SA), T₅ (T₄ + foliar spray of 0.5% K₂SO₄ at 30 and 45 DAS), T₆ (T₁ + potassium sulphate as S 10 kg/ha (SA), T₇ (T₆ + foliar spray of 0.5% K₂SO₄ at 30 and 45 DAS), T₈ (T₁ + potassium sulphate as S 20 kg/ha (SA), T₉ (T₈ + foliar spray of 0.5% K₂SO₄ at 30 and 45 DAS), T₁₀ (T₁ + ammonium sulphate as S 10 kg/ha (SA), T₁₁ (T₁₀ + foliar spray of 0.5% K₂SO₄ at 30 and 45

grain yield (12.65 q/ha), straw yield (38.39 q/ha), number of pods per plant (110.78), number of grains per pod (3.46), grain yield per plant (28.39 kg), test weight (10.33 g) and crude protein percentage (21.29%) up to application of 20 kg S per hectare in pigeon pea.

CONCLUSION

It could be concluded that application of 100 per cent RDF with potassium sulphate 20 kg/ha plus foliar spray of 0.5 per cent K₂SO₄ led to increase in the grain yield and growth components

of blackgram in Typic Rhodustalf of pulses growing areas of Madurai district, Tamil Nadu.

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