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EFFECT OF SOURCES AND LEVELS OF SULPHUR ON GROWTH AND YIELD OF RICE FALLOW BLACKGRAM (*VIGNA MUNGO*)

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ABSTRACT:

Field experiment was conducted at Annamalai University Experimental Farm, Annamalai Nagar to evaluate the effect of sources and levels of sulphur on growth and yield of rice fallow blackgram. Sulphur sources *viz.,* single super phosphate, gypsum, elemental sulphur and ammonium sulphate were tried at different levels *viz.,* 0, 20 and 40 kg S ha^{-1} in this study. The experiments consisted of twelve treatments and were laid out in factorial randomized block design with three replications. Among the sources, gypsum registered its superiority over other sources. With respect of levels, application of 40 kg S ha^{-1} recorded highest growth (plant height, leaf area index, chlorophyll content, dry matter production and number of branches $plant^{-1}$), yield components (number of pods $plant^{-1}$ and number of seeds pod^{-1}) and yield (grain and haulm) of blackgram. This study showed that supplementation of sulphur as gypsum significantly increased the growth and yield of blackgram.

KEY WORD: *Sulphur, Blackgram, Growth, Yield.*

INTRODUCTION:

Pulses are the main source of protein in the Indian diet where majority of the population comes under vegetarian category. The steady increase in the population taken together with the stagnant production of pulses over the decades resulted in insufficiency in calories and imbalance in nutritional supply. The per capita availability of pulses decreased from 60.7 g in 1951 to 35.9 g in 2000 as against the ICMR recommended pulses intake of 50 g/capita/day (Chaturvedi and Masood Ali, 2002). In recent years, there has been understandable concern about decline in the per capita availability of pulses. An important reason is the replacement of pulse crops with high yielding variety of cereals during the main seasons of kharif and rabi. A possible break through in the production of pulses in India could be achieved in two ways (1) increasing the area under pulses and (2) increasing the productivity of pulses. In India, blackgram is the most important pulse in terms of both total area and production. Currently, blackgram area in the country stands at 3.47 m.ha.with a production of 1.43 mt. In Tamil Nadu, A federal state in India, blackgram is a popular pulse crop occupying an area of 4.56 lakh hectares with a production of 2.36 lakh tonnes (Kannaiyan, 2001). There will be an increasing demand for blackgram in future. In order to achieve this increasing demand, efficient utilization of all the farming inputs as well as adoption of sound agronomic practices are essential for enhancing the productivity of blackgram.

Sulphur (S) is an essential plant nutrient plays a key role in sustaining higher production of pulse crop, is required in the formation of protein, vitamins and enzymes and its a constituent of amino acids, *viz.,* cystine, cystein and methionine. Besides, it involves in various metabolic and enzymatic process including photosynthesis, respiration and legume-rhizobium symbiotic nitrogen fixation (Srinivasa Rao *et al.* 2001).

Sulphur is one of the essential plant nutrients and its contribution in increasing the crop yields is well documented. Application of sulphur as gypsum increased plant height, dry matter production, leaf area index and straw yield of green gram (Singh et al*.,* 1994). Sulphur application through gypsum significantly increased the growth and yield of greengram (Balasubramanian and Ramamoorthy, 1999). Pandey and Singh (2001) reported that highest grain and straw yield of greengram was obtained by application of sulphur. The growth and yield potential of blackgram can be improved by optimum dose of sulphur through gypsum. Generally, a soil with less than 22 kg ha^{-1} of available sulphur is said to be deficient in sulphur. 'S' deficiency have been reported over 70 countries worldwide, of which India is one. Tamil Nadu is one of the agriculturally important states with very little documents on sulphur status. It has been found that 80% of the sample obtained from 15 benchmark clay soil in Cuddalore district were reported to be 'S' deficient (Balasubramanian et al*.,* 1990). Sulphur assumes greater significance in increasing growth and yield of pulses, as far as blackgram is concerned no work have been done earlier with regard sources and level of sulphur on growth and yield of rice fallow blackgram. Keeping this, the present experiment was planned to study the effect of sources and levels of sulphur on growth and yield of blackgram.

MATERIALS AND METHODS:

The experiment was performed on a wetland field (rice fallow condition) of Annamalai University Experimental Farm, (11°21' N and 79°44' E with an altitude of + 5.7 m a. m.s.l.), Annamalai Nagar during January – April 2003 seasons. The experimental soil was clay loam with an organic matter content of 0.51% and pH of 7.6. Available N,P,K and S contents were 235.21, 18.74,322.01 and 16.47 kg ha^{-1} respectively. Sulphur sources *viz.,* single super phosphate (S_1), gypsum (S_2), elemental sulphur (S_3) and ammonium sulphate (S_4) were tried at different levels *viz.,* 0 (L_0), 20 (L_1) and 40 (L_2) kg S ha^{-1}in this study. The experiments consisted of twelve treatments and were laid out in factorial randomized block design with three replications.

The plant height was measured from ground level to the tip of terminal leaf at harvest and recorded in cm. Leaf area index (LAI) was recorded at 45 DAS. The LAI was calculated as square cm of leaf area per unit land area divided by square cm of unit land area (Pattuswamy et al*.,* 1976). The total chlorophyll content of leaves was determined by using 80% acetone extraction suggested by Arnon (1949). The dry matter production (DMP) was recorded at harvest, five plants from each plot were selected at random from outside the net plot area and then oven dried at 65 ± 5°C until a constant weight reached and expressed in kg ha^{-1}. The numbers of branches were counted and the mean number of branches plant^{-1} was recorded at 45 DAS. Number of pods in each sample plant was counted and the mean number of pods plant^{-1} was recorded. Number of seeds pod^{-1} was recorded from ten pods selected at random in each plot. The average number of seeds pod^{-1} was recorded. Harvesting of blackgram was done from net plot area leaving two border rows all around. Well-matured blackgram plants were pulled out and sun dried for two days. Threshing was done by beating with sticks. Grain yield was recorded plot wise at 14% moisture level and expressed in kg ha^{-1}. The dry weight of haulm yield from each plot was recorded and expressed in kg ha^{-1}.

The experimental data were analysed as per the procedure outlined by Panes and Sukhatme (1978). The critical difference was worked out as five percent probability level for significant results.

RESULTS AND DISCUSSION:

Growth components

Sources and levels of sulphur significantly influenced the growth components of blackgram *viz.,* plant height, LAI, chlorophyll content, DMP and number of branches plant^{-1} (Table 1). The highest plant height, LAI, chlorophyll content, DMP and number of branches plant^{-1} was noticed under gypsum. It was followed by SSP, which was on par with ammonium sulphate. Increased growth components observed under gypsum might be attributed to readily available sulphate form of S, enhanced uptake of nutrients even at the initial stage of crop growth. Similar findings were earlier reported by Kandpal and Chardel (1993) and Sing *et al*. (1994) .The least plant height, LAI, chlorophyll content, DMP, and number of branches plant^{-1} was recorded under elemental sulphur. The poor response of elemental sulphur might be due to low oxidation rate of sulphide to sulphite and to sulphate form of sulphur. Sulphur levels were found to influence the growth components viz., plant height, LAI, chlorophyll content, DMP, and number of branches plant^{-1}. The growth components were enhanced by the higher levels of sulphur at 40 kg ha^{-1}. This might be due to the high dose of sulphur and increased availability of S along with other major nutrients. The least values recorded under 0 kg S ha^{-1}. The results are in agreement with the finding of Sharma and Room sing (1997).

Yield Components

Yield components, grain and haulm yield of blackgram were significantly influenced by sources and levels of sulphur (Table 2). Among the different sources tried, gypsum recorded maximum number of pods plant^{-1}, number of seeds pod^{-1} and 100 seed weight followed by SSP, which was on par with ammonium sulphate. These findings are in line with those of Hari Ram and Dwivedi (1992), who opined that the positive response of the crop to gypsum could be due to higher solubility and increased photosynthetic activity of crop. Regarding to levels, application of S at 40 kg ha^{-1} recorded higher yield components. This might be due to the increasing levels of sulphur application and its enhanced availability to the crop. The least values recorded under the no sulphur treatments could be due to poor availability of S and other nutrients to meet the crop demand particularly during post flowering stage. Similar findings were earlier reported by Gawande *et al*. (1994), Bhagwan Singh and Vinodkumar (1996) and Ramamoorthy *et al*. (1996).

Yield

Sulphur sources and levels significantly influenced the grain and haulm yield of blackgram (Table 2). The highest values of grain and haulm yield were recorded under gypsum. The better performance of this treatment might be due to higher solubility, nutrient availability and uptake and the result of cumulative effect of increased yield attributes. The low oxidation rate of sulphide to sulphite and to sulphate form of sulphur and non-availability of other nutrients might be caused for the low values registered under elemental sulphur. The results are in agreement with those of Singh and Ram (1990), Shivran *et al*. (1996). With respect to levels, application of 40 kg S ha^{-1} recorded the highest grain and haulm yield of blackgram. The results are in agreement with the findings of Shivakumar (2001), who reported application of with or without P increased significantly the seed yield of chickpea up to 40 kg S ha^{-1}. It might be due to increased levels of S, its availability along with major nutrients and higher uptake of crop and influencing growth and yield components of the crop, 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.

The present results show that sources and levels of sulphur significantly influenced on growth and yield of blackgram and vividly indicated that when the crop is supplemented with 40 kg S ha^{-1} through cheaper source of gypsum, the crop resulted in sustained yield increase. Hence, we concluded application of gypsum at 40 kg S ha^{-1} could be an economically viable practice that could augment the production of higher yield and return from rice fallow blackgram.

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Table 1: Effect of sources and levels of sulphur on plant height, leaf area index, chlorophyll content, dry matter production and number of branches plant^{-1} of black gram

Treatments	Plant height (cm)	Leaf area index	Chlorophyll content	Dry matter production (kg ha^{-1})	Number of branches plant^{-1}
Sources (S)					
sS_1	38.16	2.08	1.79	2653.50	7.19
S_2	39.71	2.17	1.95	2814.26	7.75
S_3	36.00	1.94	1.57	2464.92	6.56
S_4	37.53	2.03	1.72	2605.70	7.14
SED	**0.72**	**0.03**	**0.06**	**67.61**	**0.24**
CD (p=0.05)	**1.50**	**0.07**	**0.13**	**140.23**	**0.49**
Levels (L)					
L_0	32.72	1.75	0.85	2065.04	5.19
L_1	38.34	2.08	2.02	2742.81	7.39
L_2	42.49	2.33	2.42	3095.94	8.91
SED	**0.47**	**0.03**	**0.05**	**66.87**	**0.20**
CD (p=0.05)	**0.98**	**0.06**	**0.11**	**138.69**	**0.42**

Table 2: Effect of sources and levels of sulphur on number of pods plant^{-1}, number seeds pod^{-1}, grain yield and haulm yield of rice fallow black gram

Treatments	Number of pods plant^{-1}	Number of seeds pod^{-1}	Grain yield (kg ha^{-1})	Haulm yield (kg ha^{-1})
Sources (S)				
S_1	16.59	5.59	886.16	2001.55
S_2	17.67	5.83	955.86	2139.23
S_3	15.39	5.22	779.15	1817.95
S_4	16.27	5.50	859.98	1947.66
SED	**0.51**	**0.09**	**24.19**	**56.65**
CD (p=0.05)	**1.06**	**0.19**	**50.17**	**117.49**
Levels (L)				
L_0	12.40	5.11	705.69	1649.10
L_1	17.36	5.55	882.38	2018.17
L_2	19.68	5.95	1037.81	2261.95
SED	**0.46**	**0.06**	**23.27**	**55.89**
CD (p=0.05)	**0.96**	**0.13**	**48.26**	**115.86**