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Effect of different levels of nitrogen and sulphur on growth, nodulation and yield of green gram [*Vigna radiata* (L.)Wilczek]

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ABSTRACT

A field experiment was conducted at Department of Soil Science, Sam Higginbottom institute of Agriculture, Technology and Sciences Allahabad during kharif- 2010 in randomized complete block design with twelve treatment combinations consisting three levels of nitrogen (0, 20 and 40 kg N ha^{-1}) and four levels of Sulphur (0, 20, 40 and 60 kg S ha^{-1}) replicated three times. Treatment combination N_{40} S_{60} (40kg N ha^{-1} +60 kg S ha^{-1}) recorded significantly higher values for plant height (65.6cm), number of leaves $plant^{-1}$ (32.4), fresh weight $plant^{-1}$ (48.4 g) , dry weight $plant^{-1}$ (16.5 g), number of nodules $plant^{-1}$(44.5), number of pods $plant^{-1}$(25.1), and grain yield ha^{-1}(14.8 q).

Key words: Green gram, yield, nitrogen, nodules, sulphur

INTRODUCTION

Green gram [*Vigna radiata* (L.) wilczeck] is an important pulse crop cultivated in India since ancient times. It is believed that green gram is a native of India and central Asia. In India green gram occupies an area of 3.30 lakh hectares with an annual production of 1.24 lakh tonnes (Anonymous, 2009). In India green gram is cultivated in all seasons. It is grown under rainfed conditions in kharif with residual moisture in rabi season and a cash crop in summer. Green gram is also called moong, mung and mung bean is an annual legume crop grown for their seeds. Crop residues of green gram are used as fodder. Green gram is sometimes specifically grown for hay, green manure or as a cover crop. In India, generally leguminous crops are cultivated without the application of fertilizers especially nitrogenous, however, during initial growth stages these plants do depend on the available soil nitrogen till the symbiotic fixation system becomes efficient to meet their nitrogen requirement. Use of sulphur free fertilizers, limited use of organic manures, which are the source of different macro as well as micro-nutrients including nitrogen and sulphur has created deficiencies of these nutrients in the soils. The deficiency of these nutrients in the soils limits the growth and yield of various leguminous crops including green gram, indicating the need of their application. Nitrogen is an important nutrient which is required by plants. It increases growth

and development of all living tissues and protein content in pulses (Rahman *et al*., 2007). Sulphur is a plant nutrient with a crop requirement similar to that of phosphorus and is considered as the fourth major plant nutrient (Gowswamy, 1986). Sulphur is an important constituent of sulphur containing amino acids cystine, cysteine and methionine and plays vital role in regulating the metabolic and enzymatic process (Kumar and Singh, 2009). Sulphur application has been found to improve growth, yield and quality in legume crops (Singh and Singh, 1992). Combined application of nitrogen and sulphur improves the growth and yield attributes of green gram (Yadav et *al*., 1997).Keeping in view the importance of nitrogen and sulphur, an investigation has been carried out to assess the effects of nitrogen and sulphur for higher yield in green gram under Allahabad agro-climatic conditions.

MATERIALS AND METHODS

The present experiment was carried out at the experimental field of Department of Soil Science, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad during kharif-2010. The experiment was laid out in randomized complete block design (RCBD) with twelve treatment combinations consisting three levels of nitrogen (N_0 = 0 kg N ha^{-1}, N_{20}= 20 kg N $ha^{-1}$and N_{40}= 40 kg N ha^{-1}) and four levels of sulphur (S_0 = 0 kg S ha^{-1}, S_{20}= 20 kg S ha^{-1}, S_{40}= 40 kg S ha^{-1} and S_{60}= 60 kg S ha^{-1}). The seeds of green gram var. K-581 were sown in plots of 1.0 × 1.5 m size at a spacing of 30 × 15 cm in the last fortnight of August during kharif-2010. The sources of nitrogen, phosphorus, potassium and sulphur were urea, single super phosphate, muriate of potash and gypsum respectively. All recommended cultural practices were adopted to raise the crop. Observations on various growth, nodulation and yield related attributes were recorded, using standard procedures. The data thus collected was subjected to analysis of variance, using the method proposed by Panse and Sukhatme (1978).

RESULTS AND DISCUSSION

Plant height

Data presented in Table 1 indicated that increasing levels of nitrogen and sulphur significantly increased plant height. Maximum plant height of 54.1 cm was recorded with N_{40} (40 kg N ha^{-1}) which was significantly superior to rest of the nitrogen levels. Increasing dose of sulphur in the absence of nitrogen up to 60kg ha^{-1}(S_{60}) recorded maximum plant height of 57.1 cm and was found significantly superior to rest of sulphur levels. Interaction between nitrogen and sulphur was significant on plant height. Treatment combination N_{40} S_{60} (40 kg N ha^{-1} + 60 kg S ha^{-1}) recorded maximum plant height of 65.6 cm which was found significantly superior over rest of the treatment combinations.

Number of leaves

It is evident from the data in Table 1 that increasing levels of nitrogen and sulphur significantly increased number of leaves $plant^{-1}$. Application of 40 kg N ha^{-1}(N_{40}) recorded maximum number of leaves 29.2 $plant^{-1}$ which was significantly superior to rest of the nitrogen levels. Sulphur @ 60kg ha^{-1}(S_{60}) recorded maximum number of sulphur 30.1 $plant^{-1}$ and was found significantly superior to rest of sulphur levels. Interaction between nitrogen and sulphur also revealed significance of N_{40} S_{60} (40 kg N ha^{-1} + 60 kg S ha^{1}) over rest of the treatment combinations recording maximum number of leaves 32.4 $plant^{-1}$.

The increase in growth and growth related attributes of green gram due to nitrogen and sulphur could be attributed to metabolic regulation and enzymatic process including photosynthesis, respiration and symbiotic nitrogen-fixation (Yadav *et al*., 1997, Patel *et al*. 1998, Ayub *et al*. 1999, Budhar and Tamilselvan 2001, Nasreen and Farid, 2003 and Jeeven and Singh, 2009).

Fresh weight

Data presented in Table 1 indicated that increasing levels of nitrogen and sulphur significantly increased fresh weight $plant^{-1}$. Maximum fresh weight of 44.5 g $plant^{-1}$ was recorded with N_{40} (40 kg N ha^{-1}) and was found

Table 1. Effect of different levels of nitrogen and sulphur on various growth, nodulation and yield parameters in green gram.

Treatment	Plant height(cm)					Number of leaves plant^{-1}					Fresh weight plant^{-1} (g)					Dry weight plant^{-1} (g)				
	S_0	S_{20}	S_{40}	S_{60}	Mean	S_0	S_{20}	S_{40}	S_{60}	Mean	S_0	S_{20}	S_{40}	S_{60}	Mean	S_0	S_{20}	S_{40}	S_{60}	Mean
N_0	40.7	44.7	45.0	52.6	45.5	18.3	26.1	27.3	29.3	25.2	35.6	37.9	39.4	47.1	40.1	8.6	12.3	13.4	14.0	12.1
N_{20}	47.9	44.1	53.8	53.3	48.3	22.2	26.5	31.2	28.4	27.0	35.6	38.0	41.1	47.4	40.5	10.6	12.5	15.4	14.9	13.3
N_{40}	44.4	60.2	46.4	65.6	54.1	25.6	30.5	28.3	32.4	29.2	37.4	46.2	46.2	48.4	44.5	11.8	15.7	14.0	16.5	14.5
Mean	42.1	44.3	50.1	57.1	-	22.6	27.7	28.9	30.1	-	36.2	40.7	42.2	47.6	-	10.3	13.5	14.2	15.1	-
CD	N				1.5					0.8					1.6					0.5
(P = 0.05)	S				1.8					0.9					1.9					0.6
	N × S				3.1					1.6					3.3					1.0

Treatment	Number of nodules plant^{-1}					Number of pods plant^{-1}					Grain yield ha^{-1} (q)				
	S_0	S_{20}	S_{40}	S_{60}	Mean	S_0	S_{20}	S_{40}	S_{60}	Mean	S_0	S_{20}	S_{40}	S_{60}	Mean
N_0	32.2	35.6	38.2	41.3	36.8	10.8	15.9	20.9	19.8	16.8	9.2	10.6	10.4	12.8	10.7
N_{20}	33.2	42.4	44.5	40.9	40.2	13.8	17.9	21.5	22.1	18.8	10.7	10.0	12.3	13.4	11.6
N_{40}	33.7	36.5	42.1	39.4	37.9	15.1	22.8	21.9	25.1	21.2	10.6	10.1	11.7	14.8	11.7
Mean	33.1	38.1	41.6	40.5	-	13.2	18.8	21.4	22.3	-	10.1	10.2	11.5	13.6	-
CD	N				1.0					0.3					0.4
(P = 0.05)	S				1.2					0.4					0.3
	N × S				2.2					0.7					0.7

significantly superior to rest of the nitrogen levels. Sulphur @ 60 kg ha^{-1} (S_{60}) recorded maximum fresh weight of 47.6 g $plant^{-1}$ which was significantly superior over rest of the Sulphur levels. Interaction between nitrogen and Sulphur was significant. Treatment combination N_{40} S_{60} (40kg N ha^{-1} +60 kg S ha^{-1}) recorded a fresh weight of 48.4g $plant^{-1}$and was significantly superior to all other treatment combinations.

Dry weight

Data given in Table 1 revealed the significance of nitrogen and sulphur on dry weight $plant^{-1}$. Maximum dry weight of 14.5 g $plant^{-1}$ was registered with N_{40}(40 kg N ha^{-1}) which was significantly superior to rest of the nitrogen levels. Among sulphur levels, S_{60} (60kg S ha^{-1}) registered maximum dry weight of 16.5 g $plant^{-1}$ which was significantly superior over rest of the Sulphur levels. Interaction between sulphur and boron was significant on dry weight $plant^{-1}$. Treatment combination N_{40} S_{60} (40kg N ha^{-1} +60 kg S ha^{-1}) recorded maximum dry weight of 16.5 g $plant^{-1}$ which was significantly superior to all other treatment combinations ,but was statistically at par with $N_{40}S_{20}$(40kg N ha^{-1} +20 kg S ha^{-1}) .

Increase in fresh and dry weight of green gram due to N, S, and their interaction could be attributed to low soil status of available N and S of and due to the stimulating effect of applied nitrogen and Sulphur in the synthesis of chloroplast, resulting in enhanced photosynthesis which might have led to an increase in fresh and dry weight of green gram. Similar findings have also been reported by Das (1982) and Khanna and Gupta (2005).

Number of nodules per plant

Data given in Table 1 revealed the significance of nitrogen and sulphur on number of nodules $plant^{-1}$. Maximum number of nodules 40.2 $plant^{-1}$was registered with 20 kg N ha^{-1} (N_{20}) which was significantly superior to other nitrogen levels. Sulphur @ 40 kg ha^{-1}(S_{40}) recorded maximum number of nodules 41.6 $plant^{-1}$and was significantly superior to S_0 (0kg S ha^{-1}) , and S_{20}(20kg S ha^{-1}) but was at par with S_{60}(60 kg S ha^{-1}). Interaction between sulphur and boron also exhibited significant influence on number of nodules $plant^{-1}$. Treatment combination N_{20} S_{40} (20kg N ha^{-1} + 40 kg S ha^{-1}) registered maximum number of nodules 44.50 $plant^{-1}$ which was significantly superior to rest of the treatment combinations but was at par with N_{20} S_{20} (20kg N ha^{-1} +20 kg S ha^{-1}). Improvement in nodule growth due to nitrogen and sulphur could be attributed to increasing leghaemoglobin pigment formation in nodules. Our results are in conformity with the findings of other workers (Patel *et al;* 1998; Zhau *et al*; 1999 and Ahmad *et al., 2000*).

Number of pods per plant

Data presented in Table1 indicated that increasing levels of nitrogen and sulphur significantly increased number of pods $plant^{-1}$. Application of 40 kg N ha^{-1}(N_{40}) recorded maximum number of green pods 21.2 $plant^{-1}$ which was found significantly superior to rest of the nitrogen levels. Increasing dose of sulphur in the absence of nitrogen up to 60kg ha^{-1}(N_{60}) registered maximum number of pods 22.3 $plant^{-1}$ which was found significantly superior to rest of sulphur levels. Interaction between nitrogen and sulphur was significant on number of pods $plant^{-1}$. Treatment combination N_{40} S_{60} (40kg N ha^{-1} + 60 kg S ha^{-1}) recorded higher number of pods 25.1 $plant^{-1}$ which was found significantly superior over rest of the treatment combinations.

Grain yield

Data given in Table1 revealed the significance of nitrogen and sulphur on grain yield ha^{-1}. Maximum grain yield of 11.7 q ha^{-1} was registered with N_{40}(40 kg N ha^{-1}) which was significantly superior control but was statistically at par with N_{20}(20 kg N ha^{-1}). Among various sulphur levels, S_{60}(60kg S ha^{-1}) recorded maximum pod yield of 13.6 q ha^{-1} which was significantly superior over rest of the Sulphur levels. Interaction between nitrogen and sulphur was also significant on grain yield ha^{-1}. Treatment combination N_{40} S_{60} (40kg N ha^{-1} + 60 kg S ha^{-1}) registered a pod yield of 14.8 q ha^{-1} which was significantly superior

over rest of the treatment combinations. Improvement in yield and related attributes of green gram due to nitrogen and sulphur can be attributed that nitrogen is an integral part of chlorophyll and play a vital role in photosynthesis and carbohydrate production while as sulphur application promotes the process of tissue differentiation from somatic to reproductive, meristematic activity and development of floral primordial, resulting in more flower and yields. Similar findings have also been reported by other workers in green gram and other crop (Patel *et al*., 1998, Ayub *et al*., 1999, Budhar and Tamilselvan 2001, Moniruzzaman *et al*.,2008 and Kumar and Singh 2009).

REFERENCES

Ahmad, Siraj and Nasrullah. 2000. Response of black gram to nitrogen and sulphur. *Journal Agronomy Bangladesh Univ. Agric. Sci.* **8**(1): 120-130.

Anonymous, 2009. Information on area and production of pulse crops in India. Directorate of Pulse Development, Bhopal.,

Ayub, M., Tanveer, A., Choudhary, M.A., Amin, M.M.Z and Murtaza,G. 1999. Effect of growth and yield of mung bean (*Vigna radiate* L.) to various levels of nitrogen. *Pakistan Journal of Biological Science* **2**(4): 1378-1380.

Budhar, M.N. and Tamilselvan, N. 2001. Effect of sulphur on yield attributes and yield on rainfied green gram (*Vigna radiata* L.). *Madras Agricultural Journal.,* **88**(7): 504-505.

Das, G. 1982. .A stimulatory effect of low nitrate levels on nodulation leghaemoglobin control, nitrogenous activity and growth of mung bean plant. *Canadian Journal of Botany* **6**(18):1907-1910.

Gowswamy, N.N. 1986. In the forward to sulphur research and agricultural production in India. H.L.S. Tondon, F.D.C.O., New Delhi.

Jeevan, R. and Singh, M.M. 2009. Effect of nitrogen and sulphur on forage yield and quality of sorghum. *Annual Plant soil Research* **11**(1): 60-61.

Khanna, P.K. and Gupta, A. K 2005. Changes in growth, yield and some biochemical attributes in pea (*Pisum sativum*) with Rhizobium and Sulphur applications. *Journal of Plant Biology* **32**(1): 25-28.

Kumar, S and Singh, T. B. 2009. Effect of sulphur with and without rhizobium on yield and biochemical composition of black gram. *Annuals of plant Soil Research* **11**(1): 58-59.

Moniruzzaman, M., Islam, M.R. and Hasan, J. 2008. Effect of N, P, K Zn and B on yield attributes and yield of French

Bean in south Eastern hilly Region of Bangladesh. *J. Agric. Rural Dev.* **6** (1&2): 75-82.

Nasreen, S. and Farid, A.T.M. 2003. Influence of different nutrients on growth and yield of garden pea (*Pisum sativum*). *Indian Journal of Agronomy* **48**(3) : 206-209

Panse, V.G. and Sukhatme, P.V. 1978.Statistical methods for Agricultural works. ICAR, New Delhi.

Petal, J.R. and Sheike, V.B. 1998. Effect of farmyard manure, phosphorus and sulphur on growth, yield and quality of Indian mustard (*Brassica juncea* L.*). Indian Journal of Agronomy* **43**(4): 713-717.

Rahman, M.A, Hoque, A.K., Rahmam, M.S., Talukdar, M.N. and Islam, M.S. 2007. Effect of nitrogen and phosphorus on growth and yield of French bean. *J. Soil Nature* **1**(2): 30-34.

Singh, R.S. and Singh, R.P. 1992. Effect of sulphur fertilization and rhizobium inoculation on yield and nutrient content and uptake in pea (*Pisum sativum*) in diff. soils of Uttar Pradesh. *Indian Journal of Agricultural Research* **26**(2): 57-64.

Yadav, D.S., Singh, U. and Umesh, S. 1997. Studies on nitrogen and sulphur nutrition of green gram (*Phaseolus radiate* L.) in relation to growth attributes, seed protein yield and N, S uptake. *Legume research* **20** (4): 224-226.

Zhau, H.L., Puranik, R.B. and Joshi, R.P.1999.Root and nodules of gram and pea have a high demand of sulphur. *Indian Journal of Agricultural Research* **25**(2): 38-44.