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Effect of sulphur on growth and yield of green gram [*Vigna radiata* (L.) Wilczek]

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ABSTRACT

A field experiment was conducted to evaluate the effect of phospho-gypsum on green gram (Vigna radiata L.) in Gangetic alluvial soil during two successive seasons. The experiment was laid out in RBD with six treatments and four replications. The results reveal that application of Phospho-gypsum at 30 kg S / ha with the recommended dose of N-P-K (T_5) gives highest seed yield of green gram crop followed by T_3 treatment where 30 kg S / ha automatically supplied by Single Super Phosphate with the recommended N-P-K dose and T_4 treatment where Phospho-gypsum at 20 kg S / ha applied with the recommended dose of N-P-K in both the seasons. Seed yield obtained in treatments T_5 and T_3 significantly differ from T_2 treatment where recommended fertilizer dose (N-P-K) applied without any sulphur. Crop growth characters like plant height and total dry matter production also showed similar results. Phospho-gypsum was found effective and may be used as an alternate source of S for increasing the yield of green gram crop. The dose of S 20-30 kg ha^{-1}, may be optimum and better option for increasing the yield of green gram crop in an intensive cropping system where green gram is grown as a catch crop / soil restoring crop.

Key words: Growth, net production value, phospho-gypsum, sulphur, yield

Green gram [*Vigna radiata* (L.) Wilczek], commonly known as '*Mung* bean or *Moong*', being a legume crop has high demand for sulphur due to production of several protein containing materials and fatty acids, in which sulphur is an important constituent. Sulphur is required in plant for the synthesis of chlorophyll and essential for activation of certain proteolytic enzymes such as papinase. Increased use of sulphur-free fertilizers, intensive cropping, and use of high-yielding varieties have led to S deficiency in many countries. Sulphur deficiency is increasingly becoming one of the limiting factors to further sustainable increase in agricultural production. Sulphur fertilizer, besides enhancing yield and quality of crops, enhances nutrient uptake, particularly N, and fertilizer-use efficiency through interaction of sulphur with other fertilizer nutrients (Tandon and Messick, 2007). S is needed for conversion of reduced N into protein in symbiotic N fixation in pulses (like green gram), thus its positive effect on N absorption is quite likely. Residual effects have also been reported even at a low rate of 20 kg S ha^{-1}. Thus, sulphur does not need to be applied every season (De Datta *et al.,* 2005). Application of sulphur along with N, P and K to pulses and oilseeds showed greater response than to cereals. Sulphur not only improved grain yield but also improved the quality of crops (Hegde and Babu, 2004; Hegde and Murthy, 2005). Mitra *et al.* (2006) reported that green gram yield increased with increasing levels of P and S fertilizers. P at 60 kg P_2O_5 and S at 40 kg ha^{-1} gave the highest number of pods per plant, number of seeds per pod, 1000-seed weight, seed yield, net return and net return/rupee invested. However, meager information is available on the effect of Phospho-gypsum as an alternate source of S for the growth and yield of green gram crop. Hence the present investigation was aimed to study the effect of S on green gram using phospho-gypsum as one of the sources.

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MATERIALS AND METHODS

The experiment was undertaken during two successive seasons (autumn–2008 and summer-2009) to study the effect of sulphur on growth and yield of green gram [*Vigna radiata* (L.) Wilczek] crop (variety PDM-54). The experiment was laid out in RBD with 6 treatments and 4 replications at Instructional Farm (New Alluvial Zone) of Bidhan Chandra Krishi Viswavidyalaya, Nadia, West Bengal (situated at 22°56' N latitude, 88°32' E longitude and 9.75 m MSL. The soil characters of the experimental field were: pH 7.1, organic carbon 0.68%, total N 0.07%, available P_2O_5 28.3 kg ha^{-1}, and available K_2O 126.5 kg ha^{-1}and available sulphate10.3 ppm. The treatments were: T_1 = Control (No fertilizer), T_2= Fertilized control-I *i.e.* 20-40-40 N-P_2O_5-K_2O kg ha^{-1} (Recommended fertilizer dose, without any S) P through DAP, T_3 = Fertilized control-II *i.e.,* 20-40-40 N-P_2O_5-K_2O kg ha^{-1} (Recommended fertilizer dose, with S) P through SSP, T_4 = T_2 + Phospho-gypsum at 20 kg S/ha, T_5 = T_2 + Phospho-gypsum at 30 kg S ha^{-1}, T_6 = T_2 + Phospho-gypsum at 10 kg S ha^{-1}. The land preparation, pre-sowing seed treatment, sowing of seeds, irrigation application and intercultural operations such as weeding, hoeing, thinning, plant protection measures and harvesting were done as per recommended practices followed in green gram and requirement of the field. Observations on the growth characters and seed yield were taken and analyses were done for the determination of treatment effect.

RESULTS AND DISCUSSION

Table-1 showed the effect of sulphur on growth and seed yield of green gram crop. Plant height and dry aerial bio-mass were recorded at 20, 40 and 60 DAS in both the seasons. The result showed that highest plant height obtained in T_5 followed by T_3 and T_4 treatment. Treatment T_5 (Recommended N-P-K dose + Phospho-gypsum at 30 kg S/ha) and T_3 (Recommended N-P-K dose, P through SSP as a result S was added

automatically at 30 kg ha^{-1}) significantly differed from T_1 (No fertilizer) and T_2 (Recommended dose of N-P-K without any S) treatment at 20 and 40 DAS in both the seasons. Similar trend was observed at 60 DAS.

Table 1: Effect of sulphur on growth and yield of green gram crop

Treatment	Plant height (cm)						Total dry matter [dry aerial bio-mass] (kg ha^{-1})						Seed yield (kg ha^{-1})	
	Autumn–2008			Summer-2009			Autumn–2008			Summer-2009			Autumn-2008	Summer-2009
	20	40	60	20	40	60	20	40	60	20	40	60		
	Days after sowing													
T_1	6.9	44.6	43.6	11.1	36.3	43.5	104.1	1003.2	2197.2	61.918	1410.8	2115.5	608.5	587.6
T_2	7.3	47.9	46.7	11.7	39.3	50.5	116.0	1068.5	2820.4	69.625	1443.5	2304.8	706.0	697.8
T_3	8.1	52.5	54.2	12. 5	43.1	52.0	131.7	1410.5	3068.9	75.915	1635.0	2666.5	1093.7	1097.5
T_4	7.8	48.7	53.7	12.0	40.6	50.9	132.5	1344.9	2993.0	74.085	1568.3	2429.0	943.0	1072.2
T_5	8.2	53.2	54.4	12.7	43.5	54.6	135.9	1445.7	3570.5	76.083	1705.0	2693.3	1101.3	1160.0
T_6	6.8	48.4	51.9	11.8	39.9	49.65	129.4	1125.7	3237.2	75.003	1562.5	2306.8	915.0	1032.4
SEm (±)	**0.22**	**0.95**	**2.11**	**0.23**	**1.25**	**1.99**	**4.11**	**89.84**	**243.01**	**2.07**	**54.07**	**174.44**	**89.0**	**104.4**
LSD(0.05)	**0.65**	**2.87**	**6.36**	**0.71**	**3.76**	**6.01**	**12.38**	**270.81**	**732.51**	**6.25**	**162.98**	**525.83**	**268.4**	**314.7**

The result indicated that highest total dry matter production obtained in T_5 treatment followed by T_3, T_4 and T_6 treatments (Table 1). Total dry matter production in T_5 and T_3 treatments significantly differed from T_2 treatment at 20 and 40 DAS in both the seasons. At 60 DAS total dry matter production in T_5 treatment was significantly better than T_2 treatment in both the seasons. Umesh *et al.* (1997) reported similar results that application of S at 30 kg $ha^{-1}$was optimum for plant height, branch number, functional leaves, dry matter accumulation, dry weight of nodules/plant, and seed yield.

Table- 1 showed seed yield of green gram crop varied due to different level of sulphur application. The results revealed that application of Phospho-gypsum at 30 kg S ha^{-1} with the recommended dose of N-P-K (T_5) gave highest seed yield of green gram crop followed by T_3 treatment where S at 30 kg ha^{-1} was added automatically through Single Super Phosphate with the recommended N-P-K dose and T_4 treatment where Phospho-gypsum at 20 kg S / ha applied with the recommended dose of N-P-K in both the seasons. Seed yield obtained in treatments T_5 and T_3 significantly differed from T_2 treatment where recommended fertilizer dose (N-P-K) applied without any sulphur. Jat and Rathore (1994) reported that seed yield of green gram increased with sulphur application up to 30 kg ha^{-1}. Singh and Kumar (1996) also reported that application of S at 30 kg ha^{-1}significantly increased the pods per plant, 1000 seed weight and also gave highest seed and straw yields of lentil.

The net production values (NPV) of green gram crop raised in two seasons were studied. Application of nutrients from external source gave remarkably higher net profit over absolute control treatment (T_1) where no fertilizer was applied. Maximum net production values of 2.60 recorded in the treatment T_3, receiving sulphur from SSP (used as P source), followed by treatment T_5 (NPV 2.29), receiving phospho-gypsum at 30 kg S ha^{-1}, and T_4 (NPV 1.91), receiving phospho-gypsum at 20 kg S ha^{-1}. Application of S through any source increased the NPV over fertilized control treatment.

Sulphur was found to be effective on growth and yield of green gram crop. Result showed that growth and yield of green gram crop increased significantly with N-P-K applied along with sulphur through Phospho-gypsum than the crop receiving no sulphur. Therefore, Phospho-gypsum may be used as an alternate source of S for increasing the yield of green gram crop. The dose of S at 20 or 30 kg ha^{-1} may be optimum and better option for increasing the yield of green gram crop in an intensive cropping system where green gram is grown as a catch crop or soil restoring crop.

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