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A study on the effect of phosphorus and sulphur on yield of blackgram (*Vigna mungo* L.) under rainfed condition of Chitrakoot area

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Abstract
The experimental findings of the study entitled "A study on the effect of Phosphorus and Sulphur on yield of Black gram (*Vigna mungo* L.) Elucidate that application of 30 kg S/ ha with 60 kg P/ha proved the most optimum and the beneficial fertility management for the IPU 94-1 (UTTARA) variety for Chitrakoot region of M.P. These levels (S 30 P 60) resulted in maximum seed productivity of 11.33q / ha and straw yield of 12.70 q/ha.

Keywords: Blackgram, sulphur, fertility, variety, productivity

Introduction
Vigna mungo, black gram, black lentil, mungo bean (not to be confused with the much smaller true black lentil (*Lens culinaris*), blackmatpe bean, is a bean grown in the Indian subcontinent. The product sold as black lentils is usually the whole urad bean, whereas the split bean (the interior being white) is called Minumulu in Telugu, Urad Dal in Hindi, or white lentils. Black gram originated in India, where it has been in cultivation from ancient times and is one of the most highly prized pulses of India and Pakistan. Greengram contains 24.3 per cent protein rich in carbohydrates and also contains small amount of riboflavin and thiamine, also rich in phosphorus and iron. It generally grown as intercrop, mixed crop and sole crop in kharif as well as in summer season where adequate irrigation facilities are available. Sulphur containing amino acids like cystine, cysteine and methionine and promotes nodulation in legumes, also helps in increasing protein per cent in legumes and oil per cent in oilseeds and involved in the formation of chlorophyll that permits photosynthesis. (Patel et. al. 2013) [4]. Sulphur is an essential macronutrient in plant growth and development. It is increasingly being recognized as the fourth major plant nutrient after nitrogen, phosphorus and potassium. In addition, conservation-till soils are more prone to S deficiency since soil temperatures are usually lower. Low soil temperatures reduce the mineralization of organic S to sulfate, and thus increase the probability of crop responses to S fertilization. Phosphorus is vital for plant growth and is found in every living plant cell. It is involved in several key plant functions including energy transfer, photosynthesis, transformation of sugars and starches, and nutrient movement within the plant. Generally, The amounts of P taken up by different oilseeds to produce 1 tons of seed were much higher than those for cereals as rice and sorghum, as well as pulses such as chickpea and pigeonpea (Theodorou, 1993) [8]. The seed inoculation with proper strain of phosphorus solubilize bacteria is also a low cost input for enhancing yield, as it solubilize the unavailable phosphorus in to the available form, which reduce the high cost of inorganic phosphorus fertilizer (Pandey *et al*., 2001) [3]. Therefore, studies were undertaken to determine the effect of sulphur, phosphorus and inoculation of phosphorus solubilizing bacteria and its combination on greengram. (Choudhary, Jhajharia, and Kumar 2014) [1].

Material and Methods
The experiment was carried out at Rajola Agriculture farm, Mahatma Gandhi Chitrakoot Satna (M.P.) which lies in the semi- arid and sub-tropical region of Madhya Pradesh between $25^0$10' to 25^0 15' North latitude and 80^0 80' to 80^0 85' east longitude. After preparation of land, the experiment was laid out as per treatment combinations, there were 36 plots and the gross size of each plot was 5.0mx3.0m and the net plot size was 3.8mx2.0M. FYM was applied @ 10q/ha as basal dose.

A common dose of chemical fertilizers were applied @20kg. N in all the treatment Nitrogen and phosphorus where applied through Urea, DAP whereas sulphur was applied through W.P., out of total quantity of Nitrogen, phosphorus and sulphur fertilizers the full quantity of Nitrogen, phosphorus (@ 40, 50 and 60 kg/ha) and sulphur (20and 30 kg/ha). The experiment was conducted with 3 levels of Sulphur plant growth and 4 levels of Phosphorus of 12 treatment combination as indicated below.

Result and Discussion

Growth Characters

Among the growth characters, plant height and root length were studied at 20, 40 and 60 days growth intervals. Root nodules, secondary and tertiary branches per plant were also counted. The plant height and root length were increased steadily with the advancement of plant growth up to 60 days of observation. This may be due to the fact that with the increase in the stage of the activity growing plants, the root development was forming the deeper soil layers. As regards with the influence of sulphur only up to 30kg/ha increased the plant height Root nodules, secondary and tertiary branches and root length significantly. These growth parameters of black gram increased due to sulphur fertilizer. This phenomenon was quite natural because of the greater availability of this element in the soil and its stimulating effect on the growth of the plants. The height of shoot was stimulated due to sulphur which may be attributed to its essentiality in cell division. The beneficial effect of sulphur was found to be limited only up to 30kg S/ha. It is as well as known fact that plants absorb all the essential plant nutrients from soil solution in a balanced requirement quantity, and even if certain nutrients are added in excess of the plants requirement, the plant growth is likely to sulphur supported Deshbhratar *et al.* (2010) [2], The increasing levels phosphorus levels, all the above-mentioned growth parameters including Root nodules, secondary and tertiary branches per plant were increased significantly, only up to 60kg P_2O_5/ha. The crop response of applied phosphorus only up to 60kg/ha indicate the fact that the existing available - P in the experimental field soil not much deficient and only 60kg applied P proved sufficient to meet out the complete requirement of the crop plants. The beneficial effect of applied P on the growth parameter under study may be attributed to the important role of phosphorus played in the root development as well as in the translocation of photosynthesis, and being the constituent of nucleic acid, phytin and phospholipids, its application increased the height and branches per plant. The differential response of phosphorus can be attributed to its efficiency and its fertilization which in turn may be influenced by the environmental factors supported by Singh *et al.* (2013) [6].

Yield-attributes

The yield attributing parameters *viz* sulphur only up to 30kg/ha the number of pod/plant, number of seeds/pod and 1000-seed weight significantly. Further increase in sulphur application up to 30kg/ha brought about incurious influence. These parameters tended to decrease which indicate the fact that this application rate of sulphur was in excess of the crop requirement. The increase in the number of pod /plant may be due to the fact that number of root nodules were increased due to higher sulphur application only up to 30 kg/ha. The increasing levels of phosphorus up to Number of pod/plant, number of seeds/pod and 1000 seed weight were found to enhance significantly only up to 60 kg P_2O_5/ha, Father increase in phosphorus level of this parameter. Father seeds/pod and 1000-seed weight were found to decrease slightly.The higher number of pod/plant, seeds/pod and 1000 seed weight may be due to the fact that applied P enhanced the metabolic activities promoting chlorophyll formation and photosynthesis at one hand and root development completed with accelerated microbial activities on the other supported by Tahir *et al.* (2014) [7].

Productivity Parameters

The increasing levels of sulphur only up to 30kg/ha increased the grain yield (9.71q/ha) and straw yield (10.99q/ha) significantly. Thus, 30kg/ha appeared to be the optimum dose for achieving the maximum productivity of black gram Var. "IPU 94-1 (UTTARA)" under the existing agro-climatic conditions of Chitrakoot region. The increased grain and straw yields may be attributed to the accumulative effect of increased growth and yield attributing characters due to sulphur application. The increase in straw yields may be attributed to the increased growth characters *viz*. Plant height and root length plant due to application of sulphur up to 30kg/ha. The beneficial influence of sulphur application on black gram seed yield supported by Rathore *et al.* (2015) [5]. The physiological basis of variations in grain yield was mainly due to the increase in trifoliate leaf per plant, number of pods per plant and 1000 seed weight. In the present study of grain and straw yields were significantly increased due to increase in phosphorus level only up to the maximum yields were 10.15q and 11.38q/ha respectively 60kg/ha The increased grain and straw yields may be attributed to the accumulative due to phosphorus application. Moreover, phosphorus is a component of many bio-molecules involved in photosynthesis, respiration and root growth.

Table 1: Growth, yield and yield attributes of black gram as influenced by sulphur and phosphorus levels

Levels (kg/ha)	Plant height (cm)	Secondary branches/plant	tertiary branch/plant	root nodules/plant	Root Length (cm)	Pod /plant	Seeds / pod	1000seed weight (g)	Seed yield (q/ha)	Straw yield
S-level	60DAYS	20DAYS	20DAYS	60DAYS	60DAYS					
0	58.54	4.41	5.70	11.90	12.32	8.99	4.32	11.04	7.86	9.09
20	60.45	4.8	6.19	12.92	12.93	11.40	5.55	12.35	8.67	9.89
30	62.20	5.28	6.75	16.15	15.49	15.13	6.83	15.72	9.71	10.99
CD(P=0.05)	0.25	0.14	0.19	0.19	0.17	0.20	0.15	0.12	0.26	0.16
P- level										
0	56.32	3.81	5.61	11.02	11.44	9.85	4.61	10.85	7.22	8.46
40	58.01	4.60	6.06	12.73	12.91	11.40	5.13	12.07	8.27	9.64
50	61.42	5.20	6.38	14.30	14.30	12.11	5.90	13.83	9.35	10.46
60	65.84	5.81	6.8.	16.58	15.67	14.00	6.63	15.40	10.15	11.38
CD(P=0.05)	0.29	0.16	0.22	0.23	0.20	0.23	0.18	0.33	0.30	0.19
Interaction	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.

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