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EFFECT OF PHOSPHORUS AND SULPHUR ON GROWTH, YIELD AND ECONOMICS OF GREENGRAM

Mohini Punse[1], P. C. Pagar[2], Priya Rangari [3] and K.R. Siddagangamma[4]

ABSTRACT

An experiment was conducted at College of Agriculture, Nagpur to study the effect of different levels of phosphorus and sulphur on growth and yield of greengram during *kharif* season of 2016-17 in factorial randomized block design with four different levels of phosphorus *viz.*, P_1- 30 kg P ha^{-1}, P_2- 40 kg P ha^{-1}, P_3 - 50 kg P ha^{-1} and P_4- 60 kg P ha^{-1} and three different levels of sulphur *viz.*, S_1- 10 kg S ha^{-1}, S_2 -20 kg S ha^{-1}, S_3 -30 kg S ha^{-1} replicated thrice. The soil was clayey, low in nitrogen, medium in phosphorus and high in potassium with pH 7.6. Growth and yield attributing characters viz., Plant height, number of branches plant^{-1}, dry matter accumulation, leaf area plant^{-1}, number of pods plant^{-1},test weight, seed yield plant^{-1}, seed and straw yield ha^{-1}, GMR (73613 Rs. ha^{-1}), NMR (54931 Rs. ha^{-1}) and B:C ratio (3.67) were significantly more with the application of 60 kg P ha^{-1}. In case of sulphur application, the growth and yield contributing characters, yield and monetary returns were significantly increased due to application of sulphur @ 30 kg ha^{-1} which was at par with sulphur @ 20 kg ha^{-1}.

Based on present investigation it can be inferred that application of 60 kg phosphorus ha^{-1} and 30 kg sulphur ha^{-1} yielded maximum growth and yield attributes and yield of greengram. Economics of greengram also improved by the same treatment having B:C ratio of 3.94 when compared with control (2.94).

(Key words: Phosphorus, sulphur, growth, yield , economics).

INTRODUCTION

Greengram (*Vigna radiata* (L.) belongs to family Leguminoceae. It is native to India Burma region of South-East Asia. In India, the area of mungbean was 3.38 million ha with the production of 1.61 million tonnes. Its average productivity was around 474 kg ha^{-1}. In Maharashtra, the area of mungbean was 319 (000 ha) with the production of 136.9 (000 tones) and Its average productivity was around 429 kg ha^{-1}. Greengram is grown principally for Its high protein seeds that are used as human food, which can be prepared by cooking, fermenting, milling or sprouting. They are utilized in making soup, sweet, noddles, bean cake and many other culinary product like dal, papad, namkin, halwah etc. Greengram contains about 25 per cent protein. The protein comparatively rich in lysine and amino acid.

Greengram seeds are rich in carbohydrate 57-58 per cent, 1.1 per cent fat, 9.7 per cent water, 3.3-3.8 per cent fibre and 4-4.8 per cent ash and also rich in vitamins and minerals like Calcium, iron, phosphorus, potassium, riboflavin, niacin and vitamin A.

Greengram also plays an important role in sustaining soil fertility by improving soil physical properties and fixing atmospheric nitrogen . It is drought resistant crop and suitable for dryland farming and predominantly used as an inter crop with other crops.

Phosphorus is the second most important nutrient next to nitrogen. It plays a crucial role in mungbean production, phosphorus is an equally essential nutrient as a constituent of nucleoprotein, enzyme and high energy bonds. Phosphorus plays an important role in the nutrition of legume and improves biological nitrogen fixation .It also plays a vital role in the formation and translocation of carbohydrate, root development, crop maturation and resistance to disease pathogens and improve the greengram quality. Sulphur is important nutrient for optimum production of high yielding greengram. It is component of several amino acids, the building block of proteins, very important with respect to quality. It is also essential for formation of nodules on the root of legumes.

There is a paucity of response of greengram to application of phosphorus and sulphur in the typical black cotton soils of the region and hence, an attempt was made to study the effect of different levels of phosphorus and different levels of sulphur on growth and yield of greengram.

MATERIALS AND METHODS

A field experiment was conducted at Agronomy farm, College of Agriculture, Nagpur during *kharif* season of 2016-17. The experiment was laid out in factorial randomized block design with one factor using four different

1, 3 and 4. P. G. Students, Agronomy section, College of Agriculture, Nagpur (M.S.)
2. Asstt. Professor, Agronomy section, College of Agriculture, Nagpur (M.S.)

levels of phosphorus *viz.,* 30, 40, 50 and 60 kg P ha^{-1} and three different levels of sulphur *viz.,*10, 20 and 30 kg S ha^{-1} as another factor forming twelve treatment combinations replicated thrice. The soil of experimental plot was clayey in texture, low in available nitrogen (205.36 kg ha^{-1}), medium in phosphorus (19.33 kg ha^{-1}) and organic carbon (0.58 %) and very high in available potash (341.0 kg ha^{-1}) and slightly alkaline in reaction (pH 7.6).

The crop variety PKV-Greengold was used with gross plot size of 3.6 m × 4.8 m and net plot size was 2.7 m × 4.2 m. Full dose of phosphorus and half dose of nitrogen were applied at sowing and remaining half dose of N was applied at 30 DAS. In order to represent the plot, five plants of greengram from each net plot were selected randomly, labeled properly. The growth attributing characters *viz.,* plant height, number of branches $plant^{-1}$, dry matter accumulation at harvest and leaf area $plant^{-1}$ were recorded at 45 DAS and yield attributing characters and yield *viz.,* number of pods $plant^{-1}$, test weight, seed yield $plant^{-1}$, seed and straw yield (kg ha^{-1}) were also recorded at harvest.The gross monetary and net monetary returns along with B:C ratio were calculated.

RESULTS AND DISCUSSION

Effect on growth attributes

The data pertaining to various growth attributes studied viz., plant height, number of branches $plant^{-1}$, dry matter accumulation and leaf area $plant^{-1}$ as influenced by various treatments are presented in table 1.

Phosphorus levels

Data in table 1 revealed that plant height, number of branches $plant^{-1}$, dry matter accumulation (g) and leaf area $plant^{-1}$(dm^2) in greengram were significantly affected due to different levels of phosphorus and was significantly more with the application of 60 kg P ha^{-1} and comparable to 50 kg P ha^{-1}. Hamza *et al.* (2016) reported that application of phosphorus @ 60 kg ha^{-1} recorded highest plant height of greengram. Significant increase in plant height might be due to more availability of phosphorus, vigorous root growth and enhanced metabolic rate and cell elongation which led to higher plant height. Kumar *et al.* (2009) stated that application of phosphorus produced the highest number of branches. The significant increase in number of branches might be due to the better supply of phosphorus enhanced crop growth by the cell enlargement in meristematic region and there by more plant height ultimately increased the nodes and internodes and more number of branches. Singh *et al.*(2009) reported that the increased leaf area $plant^{-1}$ was due to more number of functional leaves and area available to crop as attempted by greater nutrient availability that resulted in more cell division and cell increment. Sharma *et al.* (2003) reported that significant role of phosphorus in the transformation of energy required in cell division, ATP activation of amino acids for synthesis of protein and carbohydrate metabolism which reflected into higher dry matter production at higher phosphorus levels.

Sulphur levels

Data revealed that plant height, number of branches, leaf area $plant^{-1}$and dry matter accumulation $plant^{-1}$ of green gram were significantly affected due to application of sulphur and were significantly maximum with the application of sulphur @ 30 kg ha^{-1} but remained at par with the application of 20 kg S ha^{-1}. Application of sulphur might be due to effect of sulphur in metabolism of growing plants.It is directly related with cell division, enlargement and elongation, vigorous root growth and formation of chlorophyll resulting in higher photosynthesis which led to higher plant height (Kaisher *et al.*,2012). Kumar *et al.*(2013) reported that application of sulphur increased the number of branches $plant^{-1}$ with the application of sulphur may be because of height as well as due to efficient biosynthesis of proteins and amino acids that leads to cell division and increment in height of plant that induces greater branches. Meena *et al.* (2013) reported that leaf area $plant^{-1}$ of green gram was significantly influenced due to application of sulphur. Effect of sulphur on green gram plant that had increased the height and more number of branches of greengram which induced more number of leaves. Singh *et al.*(2013) reported that dry matter accumulation due to significant role of sulphur in cell division and differentiation ,root elongation which reflected into higher absorption of nutrients and formation of photosynthates which reflected into higher dry matter production.

Effect on yield attributes

Data pertaining to various yield attributes studied as influenced by various treatments are presented in table 1.

Phosphorus levels

Different levels of phosphorus significantly influenced yield attributes of green gram. Highest number of pods $plant^{-1}$ and seed yield $plant^{-1}$ were recorded with the application of 60 kg phosphorus ha^{-1} but it was at par with 50 kg P ha^{-1} and significantly superior over 30 and 40 kg P ha^{-1}. Ali *et al.* (2014) reported that significant role of phosphorus in photosynthesis by way of rapid energy transfer and thereby increased photosynthetic efficiency and thus increased the availability of photosynthates. This resulted in increased total biomass production and their translocation in various plant parts which ultimately increased number of pods $plant^{-1}$ in green gram. Chaudhari *et al.* (2015) found that seed yield $plant^{-1}$ of greengram was significantly influenced by different phosphorus levels. Significant increase in seed yield $plant^{-1}$ of green gram might be due to increased number of pods $plant^{-1}$ and growth attributes that may turn increased translocation of photosynthates to seed production. However, application of phosphorus 60 kg ha^{-1} showed higher test weight amongst all the treatments. Higher seed yield (kg ha^{-1}) might be due to the cumulative favourable effect of the higher number of effective pods $plant^{-1}$ and seed yield $plant^{-1}$ occurred due to better plant metabolism which in turn produced higher seed yield (kg ha^{-1}) (Ram and Dixit, 2001). Abbas *et al.* (2011) stated that the straw yield (kg ha^{-1}) of greengram was significantly influenced due to phosphorus application. Higher straw yield might be due to the increased level of phosphorus that increased growth and development in terms of plant height, branches and dry matter accumulation as a result of improved nutritional environment in rhizosphere and plant system.

Sulphur levels

Various sulphur levels significantly influenced yield attributes of greengram. Highest number of pods plant^{-1} , seed yield plant^{-1}, seed yield (kg ha^{-1}) and straw yield (kg ha^{-1}) in greengram were obtained with the application of sulphur @ 30 kg ha^{-1}, which was at par with sulphur @ 20 kg ha^{-1} and significantly more over 10 kg S ha^{-1}. Mazed *et al.* (2014) found that the significant increase in number of pods plant^{-1} due to application of sulphur might be due to involvment of sulphur in synthesis of fatty acids and also increased protein content through the synthesis of different amino acids that had increased more number of pods plant^{-1}. Significant increase in seed yield plant^{-1} of green gram might be due to improved nitrogenase activity and nitrogen fixation which increased dry matter production that is translocated to seed production and with application of sulphur various processes such as cell division, flowering and fruiting, water relations that increased the growth attributes which ultimately increased the yield attributes and also the increase in seed yield plant^{-1} and test weight (Singh and Yadav, 1997). Bairawa (2014) observed that the higher seed yield (kg ha^{-1}) might be due to the cumulative favourable effect of the higher number of effective pods plant^{-1} and seed yield plant^{-1} due to greater availability of nutrients and plant metabolism which in turn produced higher seed yield (kg ha^{-1}). Mazed *et al*.(2014) observed that highest straw yield (kg ha^{-1}) might be due to the fact that sulphur encourages above ground vegetative growth due to increased synthesis of amino acids and fatty acids and merristimatic activity that enhanced higher dry matter accumulation.

Economic studies

Data on gross monetary returns, net monetary returns and B:C ratio as affected by various treatments are presented in table 1.

Phosphorus levels

Gross monetary returns (Rs 73613 ha^{-1}) and net monetary returns (Rs 54931 ha^{-1}) were highest with the application of 60 kg P ha^{-1} which was significantly superior over 30 and 40 kg P ha^{-1} but remained at par with 50 kg P ha^{-1}. Highest B:C ratio was obtained with the application of phosphorus @ 60 kg ha^{-1} (3.94) and followed by the application of 50 kg P ha^{-1} (3.82). Tahir *et al.* (2015) reported that the application of 60 kg P ha^{-1} recorded significantly highest B:C ratio.

Sulphur levels

The gross monetary returns and net monetary returns were significantly influenced due to various levels of sulphur. Application of sulphur @ 30 kg ha^{-1} recorded significantly higher gross and net monetary returns over application of sulphur 10 kg ha^{-1} but was at par with the application of 20 kg sulphur ha^{-1}. The B:C ratio was maximum with the application of sulphur @ 30 kg ha^{-1} (3.82) followed by sulphur @ 20 kg ha^{-1} (3.74). Malik *et al*. (2003) reported that the highest GMR and NMR were found with the application of sulphur @ 30 kg ha^{-1}.

Interaction effect

Interaction effect between phosphorus and sulphur levels were found non significant in case of growth and yield attributes, yield and monetary returns of greengram.

Based on present investigation it can be inferred that application of 60 kg phosphorus ha^{-1} and 30 kg sulphur ha^{-1} yielded maximum grain and dry matter, growth contributing characters and economics of green gram also improved.

Table 1. Growth and yield attributes, yield and economics of *kharif* mungbean (green gram) as influenced by different levels of ~~sulphur and boron~~

Treatments	Growth attributes				Yield attributes			Yield		Economics		
	Plant height (cm)	No. of branches plant^{-1}	Lear area plant^{-1} (dm^2)	Dry matteor accumu-tion plant^{-1} (g)	No. of pods plant^{-1}	Seed yield plant^{-1} (g)	Test weight (g)	Seed yield (kg ha^{-1})	Straw Yield (kg ha^{-1})	Gross Monetary return (Rs. ha^{-1})	Net Monetary return (Rs. ha^{-1})	B:C Ratio
Phosphorus levels (P)												
P_1 - 30 kg P ha^{-1}	47.08	5.65	4.25	18.74	23.14	6.99	31.28	1033	1676	52831	34869	2.94
P_2 - 40 kg P ha^{-1}	48.42	6.09	5.01	19.71	24.94	7.11	31.80	1187	1747	61204	43001	3.36
P_3 - 50 kg P ha^{-1}	49.43	6.42	5.86	20.59	25.68	7.46	32.083	1355	1971	70419	51735	3.82
P_4 - 60 kg P ha^{-1}	53.81	7.18	6.58	22.85	26.81	7.90	32.88	1412	2059	73613	54931	3.94
SE (m) ±	1.50	0.28	0.24	0.77	0.45	0.16	0.79	30	34	1089	1089	-
CD at 5%	4.40	0.81	0.74	2.31	1.32	0.47	-	90	102	3196	3196	-
Sulphur levels (S)												
S_1- 10 kg S ha^{-1}	46.15	5.67	4.98	18.09	23.55	6.90	31.50	1146	1763	60605	43013	3.44
S_2 - 20 kg B ha^{-1}	49.65	6.49	5.29	20.89	25.53	7.62	31.89	1260	1878	67202	48906	3.74
S_3 - 30 kg S ha^{-1}	53.60	6.83	6.10	22.99	26.58	7.97	32.82	1310	1932	69966	51674	3.82
SE (m) ±	1.36	0.16	0.23	0.75	0.39	0.14	0.68	28	32	943	943	-
CD at 5%	3.97	0.40	0.71	2.20	1.14	0.41	-	84	96	2768	2768	-
Interaction (P X S)												
SE (m) ±	2.71	0.32	0.44	1.50	0.78	0.28	1.37	42	64	1887	1887	-
CD at 5%	-	-	-	-	-	-	-	-	-	-	-	-

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