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Research Article

Effect of Phosphorus and Sulphur on the Growth and Yield of Green Gram (*Vigna radiata* L.)

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ABSTRACT

The field experiment was conducted during the kharif season of 2019-20 to find out the effect of phosphorus and Sulphur on growth and yield of green gram, at the Research Farm, School of Agriculture, ITM University, Gwalior, (M.P.). The experiment consisted of randomize block design having Factorial arrangement with three replications. In this experiment, 12 treatment combinations including four levels of phosphorus as P_0- 0 kg/ha, P_1- 25 kg/ha, P_2- 45 kg/ha and P_3- 65 kg/ha, while three levels of Sulphur were tested are S_1- 10 kg/ha, S_2- 20 kg/ha and S_3- 30 kg/ha. During the experiment, it was found that phosphorus and Sulphur significantly affected plant height, number of branches per plant, number of leaves per plant, number of root nodules per plant, grain and Stover yield of green gram at maximum crop growth stage. Highest plant height, number of branches per plant, number of leaves per plant and number of root nodules per plant at maximum crop growth stage (56.27 cm, 11.96, 11.98, and 17.98, respectively) was recorded in plots treated with phosphorus @ 60 kg/ha combined application with Sulphur @ 60 kg/ha. Similarly, resulted in highest grain and Stover yield (11.47 and 28.46 q/ha, respectively) recorded under same treatment combination of phosphorus @ 65 kg/ha combined application with Sulphur @ 30 kg/ha. It was concluded from the results that application of phosphorus @ 65 kg/ha combined application with Sulphur @ 30 kg/ha improved growth as well as grain yield of green gram.

Keywords: *Green gram, Sulphur, Phosphorus, Root nodules, Stover yield.*

INTRODUCTION

Pulses in India have long been considered as the poor man's only source of protein. Pulses are grown on 22-23 million hectares of area with an annual production of 13-15 million tonnes. Pulses are grown globally covering large dimension of about 70.50 million hectares in area with the total production of 57.27 million tonnes. Green gram (*Vigna radiata* L. Wilczek) is oneof the most ancient and extensively grown leguminous crops of India.

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It is a short duration crop and rich in protein and vitamin B. In India it is cultivated in Maharashtra, Andhra Pradesh, Rajasthan, Orissa and Karnataka. It can be grown under wide range of soil types. It is grown usually as rain fed crop but can also be grown as pre-monsoon and late monsoon crop. In India it occupies3.4 million ha area with a production of 1.4million tonnes with the average yield 475 kg per ha (2014-15).

Phosphorus is an essential both as a part of several key plant structure compound and as catalysis in the conversion of key biochemical reaction in plant. Phosphorus is a vital component of ATP, the "energy unit" of plants. ATP forms during photosynthesis in its structure, and processes from the beginning of seedling growth through to the formation of grain and maturity. Some specific growth factors that have been associated with phosphorus are: stimulated root development, increased stalk and stem strength, improved flower formation and seed production, more uniform crop maturity, increased N-fixing capacity of legumes, improvements in crop quality, and increased resistance to plant diseases.

Plant requires as much sulfuras phosphorus one of the elements usually considered major plant nutrient. In general, Sulfur is essential for synthesis of vitamins (biotin and thiamine), Scontaining amino acids (cystine, cysteine and methionine) and promotes nodulation in legumes. It activates certain enzyme systems and is a component of some vitamin (vitamin-A). Sulfur fertilization also been shown to increase oil content of crop suchas soybean and flax. Sulfur is the key nutrient for improving productivity of legume crop. The decreasing per capita availability of pulse of the country has been serious concern. To make up this short fall it is necessary to boost up the pulse production in country. Considering the importance of phosphorus and Sulphur, this experiment was conducted to investigate the impact of phosphorus and Sulphur levels on growth and yield of green gram.

MATERIALS AND METHODS

The experiment was carried out at the Research Farm, School of Agriculture, ITM University, Gwalior, (M.P.) during the year 2018-19. The experiment was conducted in randomize complete block design having Factorial concept with three replications. Different rates of phosphorus and Sulphur allocated to the plots as per treatments. The green gram variety was tested for this experiment along with these treatments. The treatments were four levels of phosphorus as P_0- 0 kg/ha, P_1- 25 kg/ha, P_2- 45 kg/ha and P_3- 65 kg/ha, while three levels of Sulphur were tested are S_1- 10 kg/ha, S_2- 20 kg/ha and S_3- 30 kg/ha. The gross and net plot size was 6.0 m x 2.5 m and 5.0 m x 2.0 m, respectively. The fertilizers grades were applied as per treatments. The recommended dose of nitrogen and Sulphur was applied @ 30 P_2O_5 kg/ha and 40 kg K_2O /ha, respectively. Nutrients, phosphorus (P_2O_5) and Sulphur was applied as per the treatments. All the other agronomic practices were applied uniformly to all the treatments.

RESULTS AND DISCUSSION

EFFECT OF PHOSPHORUS AND SULFUR ON GROWTH ATTRIBUTES

Various treatments were affected significantly on the plant height number of branches per plant, number of leaves per plant, number of root nodules per plant of the crop. The data pertaining to growth characters of crop is given in Table 1. Among the treatments, the highest plant height, maximum number of branches per plant, number of leaves per plant, number of root nodules per plant (55.02 cm, 10.65, 10.99, and 16.96, respectively) were recorded in plots treated with the application of phosphorus @ 65 kg/ha (P_3) while, lowest values were observed in plot that received no phosphorus. Similarly, application of Sulphur @ 30 kg/ha gave maximum plant height, number of branches per plant, number of leaves per plant, number of root nodules per plant value of 53.88 cm, 9.83, 10.90, and 15.88, respectively.

Data indicated that interaction effect of phosphorus and Sulphur significantly affected plant growth was found significant. Similarly, in interaction the highest plant height, number of branches per plant, number of leaves per plant, number of root nodules per plant was recorded from plot receiving phosphorus @ 65 kg/ha combined application with Sulphur @ 30 kg/ha, value of 56.27 cm, 11.96, 11.98, and 17.98, respectively while minimum was recorded from plot receiving 0 kg/ha phosphorus with application of Sulphur of 10 kg/ha.

These may due to increasing levels of phosphorus significantly increased growth parameters like plant height and branches could attributed to the role of phosphorus in growth by promoting extensive root development nodulation. It may improve the supply of nutrients and water from the deeper soil layers for higher photosynthetic activity. Sulfur application increased rate of photosynthesis due to enhanced the protein synthesis and maintenance of high chlorophyll content. Thus, it ultimately increases the plant growth parameters. Similar results were found by Aulakh and Pasricha (1999).

This increase in growth parameters may be attributed to better nutritional environment for plant growth and development not only due to increased availability of phosphorus in soil but of other nutrients too, which are considered vitally important for growth and development. The overall improvement in crop growth under the influence of phosphorus application could be ascribed to better root development and proliferation and increased nitrogen fixation in the soil improving thereby the nitrogen status in the soil. The increase in photosynthetic activity in plant led to overall development in terms of growth. Thus, phosphorus fertilization enhanced the photosynthesis and other metabolic processes in the plant which ultimately enhanced growth in terms of total and effective root nodules per plant and chlorophyll content. Similar results have also been reported by Singh et al. (2011).

It is obvious, because of the fact that application of Sulphur has been reported to improve not only the availability of sulphur itself but of other nutrients too, which are considered important for the growth and development of plant. The improvement in overall vegetative growth of the crop with the application of sulphur in present investigation is in cognizance with the findings of Prajapat et al. (2011) and Kumawat et al. (2014). The increased growth parameter may be attributed to increased cell division due to sufficient supply of Sulphur and phosphorus. Vegetative growth mainly consists of new leaves, stem and nodules. Photosynthetic products transported to these sites are used predominantly in the synthesis of protein. Similar reasons were also proposed by Chandra and Pareek (2007).

EFFECT ON YIELD ATTRIBUTES AND YIELD

Data regarding highest grain and Stover yield are reported in (Table- 1). Statistical analysis of the data revealed that maximum grain and Stover yield (34.69 q/ha and 47.43 q/ha, respectively) were recorded in plots treated with the application of phosphorus @ 65 kg/ha (P_3) while, lowest values were observed in plot that received no phosphorus. However, application of Sulphur @ 30 kg/ha gave highest grain and Stover yield value of 35.54 q/ha and 45.93 q/ha, respectively.

Statistical analysis of data revealed that interaction effect of phosphorus and Sulphur significantly affected grain and Stover yield were found significant. Similarly, in interaction the maximum values of these parameters were recorded from plot receiving phosphorus @ 65 kg/ha combined application with application of Sulphur @ 30 kg/ha, value of 39.02 q/ha and 48.25 q/ha, respectively while minimum values were recorded from plot receiving 0 kg/ha phosphorus with application of Sulphur of 10 kg/ha.

It can be seen from the data that phosphorus and sulfur application significantly increased the yield as compared to control. It might be due to phosphorus and sulfur increased the production of plant biomass, nodule number and weight and chlorophyll content in leaf exhibited significant positive

correlation with grain and stover yield. Similar results were reported by Singh and Singh (2004) and Deshbhratar et al. (2010).

Since, an adequate supply of phosphorus during early stage of growth is considered important in promoting vegetative growth and branching by influencing cell division and elongation in meristem matic cells thereby increasing the sink in terms off lowering and seed setting. These findings corroborate the results of Choudhary et al. (2014), Tiwari et al. (2015). Yield of a crop is the cumulative effect of yield attributing characters like pods/plant, seeds/pod and test weight. Thus, the grain yield of mungbean also increased significantly due to sulphur fertilization. Significant and positive correlation between seed yield and yield attributes also supports higher seed yield obtained in the present investigation. The increase in straw yield due to sulphur application might be due to the cumulative effect of increased plant height, number of leaves per plant and number of branches/plant i.e. increased growth parameters. Yadav (2004) and Kumawat et al. (2006) in mungbean also provided support to the findings of the present investigation.

Successive increase in level of phosphorus and sulphur tended to increase significantly in yield attributes, grain and straw yields. The improvement in yield attributes seems to be due to the balanced nutritional environment. Supply of sulphur in adequateamount helps in the development of floralprimordia i.e. reproductive parts which results in the development of pods and grains in plant. Thus, the application of sulphur might have increased the yield attributing parameters in green gram. The positive influence of sulphur fertilization on N, P, K and S content of the crop seems to be due to improved nutritional availability both in rhizosp here and the plant system as well As discussed in preceding paragraphs. These findings are in accordance with the findings of Kumawat et al. (2007) and Bahadur et al. (2009) in green gram.

Table 1: EFFECT OF PHOSPHORUS AND SULPHUR ON GROWTH AND YIELD OF GREEN GRAM

Treatment	Plant height (cm)	Number of branches per plant	Number of leaves per plant	Number of root nodules per plant	Grain yield per hectare (q/ha)	Stover yield per hectare (q/ha)
	Effect of phosphorus levels					
P_0	50.11	7.62	8.72	13.02	4.55	14.15
P_1	51.64	8.53	10.08	13.93	6.45	19.66
P_2	54.56	9.86	10.77	16.48	8.63	23.75
P3	55.02	10.65	10.99	16.96	9.38	25.42
S. Em±	0.26	0.19	0.16	0.13	0.18	0.41
CD	0.77	0.54	0.46	0.37	0.52	1.19
S_1	51.51	8.52	9.56	14.36	6.09	18.44
S_2	53.12	9.15	9.96	15.05	7.08	20.64
S_3	53.88	9.83	10.90	15.88	8.58	23.15
S. Em±	0.23	0.16	0.13	0.11	0.15	0.35
CD	0.67	0.47	0.40	0.32	0.45	1.03
P_0S_1	49.89	7.14	7.79	12.58	3.95	12.36
P_1S_1	50.43	8.37	9.98	13.37	6.22	19.08
P_2S_1	52.83	8.85	10.19	15.32	6.82	20.34
P_3S_1	52.87	9.73	10.26	16.16	7.37	21.97
P_0S_2	50.13	7.85	8.51	13.19	4.50	14.09
P_1S_2	51.75	8.52	10.11	13.69	6.42	19.66
P_2S_2	54.67	9.94	10.51	16.59	8.10	22.99
P_3S_2	55.91	10.27	10.72	16.73	9.28	25.84
P_0S_3	50.32	7.86	9.86	13.28	5.19	16.00
P1S3	52.73	8.69	10.14	14.73	6.71	20.22
P_2S_3	56.19	10.79	11.61	17.53	10.97	27.90
P_3S_3	56.27	11.96	11.98	17.98	11.47	28.46
S. Em±	0.46	0.32	0.27	0.22	0.31	0.70
CD	1.34	0.94	0.79	0.64	0.90	2.06

CONCLUSION

Based upon this experiment it is concluded that application of higher level of phosphorus at the rate of 65 kg/ ha combined application with Sulphur at the rate of 30 kg/ ha recorded the maximum growth and grain yield of green gram.

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