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RESEARCH PAPER

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

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Abstract : A field experiment undertaken to study the effect of sulphur and phosphorus on growth, yield and quality of summer green gram [*Vigna radiata* (L.)Wilczek] during summer 2010. The results of the present investigation showed that significantly the highest plant height (43.53 cm), number of branches per plant (5.79), leaf area index (3.97, 4.17 and 4.65 at 20, 40 and 60 DAS, respectively) and dry matter content (4.64, 7.63 and 10.65 g/plant at 20, 40 and 60 DAS, respectively) were observed in treatment S_3 (30 kg S/ha). With respect to yield attributes and yield the results indicated that significantly the maximum number of pods per plant (20.47), weight of 100 seeds (4.07 g), seed yield (819 kg/ha) and straw yield (1551 kg/ha) were found with the application of 30 kg S/ha. With respect to phosphorus, the results revealed that the application of phosphorus @ 60 kg P_2O_5/ha (P_3) registered significantly the highest plant height (43.85 cm), number of branches per plant (5.70), leaf area index (3.97, 4.17 and 4.65 at 20, 40and 60 DAS, respectively) and dry matter content (4.65, 7.63 and 10.64 g at20, 40 and 60 DAS, respectively). In case of yield attributes and yield, the results showed that significantly the maximum number of pods per plant (20.83), weight of 100 seeds (4.03 g), seed yield (814 kg/ha) and straw yield (1563 kg/ha) were found with the application of 60 kg P_2O_5/ha. A combined application of 30 kg S/ha and 60 kg P_2O_5/ha (S_3P_3) was found significantly higher in respect of grain yield (937 kg/ha) and straw yield (1853 kg/ha).

Key Words : Summer green gram, Sulphur, Phosphorus, Growth, Yield attributes, Yield

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INTRODUCTION

Pulses are the important crops in our country and the main source of vegetable protein. The major protein component of Indian diet comes from pulses. The protein from pulses is easily digestible, relatively cheaper and higher biological values. The lysine rich proteins of pulse share considered to supplement the deficiency of this amino acid in cereal dietaries and because of this reason pulses called as "poor man's meat". Pulses can be successfully raised in summer where adequate irrigation facilities are available. Contrary to rainy season problem, summer provides ideal condition for raising pulse as it is free from erratic rainfall, cloudy weather etc. with full sunshine, high temperature and low humidity in summer. The less incident of pest and diseases due to its short duration nature as well as nutritional values of food and feed, possibilities for increasing area under cultivation of this crop in summer are quite obvious. Green gram is one of the major pulse crops in India, which is cultivated in arid and semi-arid region. It is also called as *Moong*, *Mungo* or golden gram. It originated in the Indo-Burma and area of South East Asia. Green gram contains about 24.3 per cent protein and is a good

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source of riboflavin and thiamine. The straw and husk yields are used as fodder for cattle. It is good green manure and erosion resisting cover crop. The crop also improves soil fertility by symbiotic fixation of atmospheric nitrogen. The grains are mainly used as *Dal* or to make flour. Green pods are used as vegetables. Fertilizers, even though comparatively a costly input of production, are essential for securing higher yields. The prudent use of fertilizers with appropriate method and time of application are of the prime importance in securing higher and economic yield. Sulphur and phosphorus play a vital role in the nutrition of plants. In fact; these are the nutrients, which lack mostly in the soils. Analysis of Indian soils has indicated that, soils are medium to low in the phosphorus and deficient in sulphur.

MATERIAL AND METHODS

The present experiment entitled Effect of sulphur and phosphorus on growth, yield and uptake of summer green gram [*Vigna radiata* (L.)Wilczek] was carried out during summer season of 2010 at Instructional Farm, Department of Agronomy, Junagadh Agricultural University, Junagadh. The experiment comprised of sixteen treatment combinations of sulphur and phosphorus with four levels of each were laid out in Factorial Randomized Block Design with three replications.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Effect of sulphur :

Data presented in Table 1 indicated that plant height, number of branches per plant and leaf area index at 20, 40 and 60 DAS and dry matter content at 20, 40 and 60 DAS were significantly influenced by the different levels of sulphur. Fertilizing the crop with 30 kg S/ha considerably increased the plant height, number of branches per plant, leaf area index and dry matter content at 20, 40 and 60 DAS. This might be due to known role of sulphur in stimulation of cell division, photosynthetic process as well as formation of chlorophyll. It also promotes the root nodules in legumes, which cause the more sulphur available during vegetative growth period and development of plant occurs. These results are in accordance with those of Yadav (2004) and Srivastava *et al.* (2006) with respect to plant height and number of branches per plant in green gram.

The yield attributing characters *viz.*; numbers of pods per plant and 100-grains weight (Table 2) were significantly influenced by different levels of sulphur. The application of 30 kg S/ha gave highest number of pods per plant and 100-grains weight. Increase in different yield attributing characters might be due to more availability of sulphur during these vegetative and reproductive stages of the crop. Sulphur is a part of amino acid (Cystine), which helps in chlorophyll formation, photosynthetic process, activation of enzymes and grain formation. Rise in different yield attributing characters like number of pods per plant and 100-grains weight also recorded by Budhar and Tamilselvan (2001), Singh and Yadav (2004) and Mitra *et al.* (2006) in green gram.

The results (Table 2) revealed that grain yield of green gram was recorded highest (819 kg/ha) under 30 kg S/ha (S_3), which was 21.50 per cent higher over control. This increase in

Table 1 : Effect of sulphur and phosphorus levels on growth parameters of green gram

Treatments	Plant height (cm)	Number of branches per plant	Leaf area index (LAI)			Dry matter content (g/plant)		
			20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS
Sulphur (kg/ha)								
$S_{0\,(00)}$	39.17	5.12	3.12	3.32	3.72	3.72	6.72	9.74
$S_{1\,(10)}$	41.25	5.42	3.52	3.72	4.13	4.13	7.08	10.10
$S_{2\,(20)}$	41.70	5.51	3.69	3.89	4.30	4.30	7.30	10.32
$S_{3\,(30)}$	43.53	5.79	3.97	4.17	4.65	4.64	7.63	10.65
S.E. ±	0.53	0.08	0.08	0.08	0.07	0.08	0.13	0.14
C.D. (0.05)	1.53	0.23	0.24	0.24	0.19	0.24	0.37	0.40
Phosphorus (kg/ha)								
$P_{0\,(00)}$	40.88	5.13	3.16	3.36	3.76	3.75	6.76	9.78
$P_{1\,(20)}$	41.21	5.41	3.50	3.70	4.11	4.11	7.11	10.13
$P_{2\,(40)}$	43.71	5.61	3.68	3.88	4.28	4.28	7.24	10.25
$P_{3\,(60)}$	43.85	5.70	3.97	4.17	4.65	4.65	7.63	10.64
S.E. ±	0.53	0.08	0.08	0.08	0.07	0.08	0.13	0.14
C.D. (0.05)	1.53	0.23	0.24	0.24	0.19	0.24	0.37	0.40
C.V. (%)	4.33	4.98	7.96	7.53	5.50	6.98	6.09	4.70

grain yield with increasing levels of sulphur might be due vital role played by sulphur in accelerating the yield attributes *viz*., number of pods per plant and 100-grains weight (Table 2). It was also observed that straw yield was significantly highest (1551 kg/ha) in 30 kg S/ha (Table 2), which was 26.77 per cent higher over control. The positive effect of sulphur on straw yield may be due to the pronounced role of sulphur in stimulation of cell division, photosynthetic process as well as formation of chlorophyll. It also promotes the root nodules in legumes, which cause the more sulphur available during vegetative growth period and development of plant occurs. It resulted in higher plant height and number of branches per plant (Table 1) and ultimately helped in realization of higher straw yield. The findings are akin to the report of Singh and Yadav (2004), Mitra *et al.* (2006) and Kadam *et al.* (2006) in green gram.

Effect of phosphorus :

Application of 60 kg P_2O_5/ha significantly increased the plant height, number of branches per plant, leaf area index at 20, 40 and 60 DAS and dry matter content at 20, 40 and 60 DAS over control (Table 1). Phosphorus not only plays an important role in root development and proliferation but also improves nodulation and N fixation by supplying assimilates to the roots. It is the main constituent of co-enzymes, ATP and ADP which act as "energy currency" within plants. Almost every metabolic reaction of any significance proceeds via phosphate derivatives. Thus, phosphorus influenced photosynthesis, biosynthesis of protein and phospholipids, nucleic acid synthesis, membrane transport and cytoplasmic streaming. Increased availability of phosphorus owing to its application in the soil which was otherwise low in phosphorus content, improved the availability of nutrients, resulting into more uptake of N, P and K by the crop. The greater uptake of nutrients might have increased the photosynthesis and then translocation of metabolites to different parts for promoting meristematic development in potential apical buds and intercalary meristem which ultimately increased root and shoot development in terms of growth parameters. These results are in agreement with those of Kumar and Chandra (2003) and Luikham *et al.* (2005) in green gram.

Application of graded levels of phosphorus significantly increased the number of pods per plant and weight of 100 seeds (Table 2). The regulatory functions of phosphorus in photosynthesis and carbohydrate metabolism in leaves can be considered to be one of the major factors limiting plant growth particularly during the reproductive phase. The level of phosphorus during this period regulates starch/sucrose ratio in the source leaves and the reproductive organs (Giaqinta and Quebedeaux, 1980). Probably, this effect of phosphorus on partitioning is also responsible in part for the insufficient photosynthetic supply to the modulated roots of legumes grown on phosphorus deficient soils. Phosphorus deficiency limits N fixation mainly by reducing the growth of host plant. Thus, application of phosphorus might have resulted in increased carbohydrate accumulation and their remobilization to reproductive parts of the plant, being the closest sink and hence, resulted in increased flowering, fruiting and seed formation. These findings corroborate the results of Singh and Sharma (2001) and Choudhary *et al.* (2003) in green gram.

Significant increase in seed yield was recorded with the application of 60 kg P_2O_5/ha as compared to lower levels and control (Table 2). This might be due to the concomitant increase in number of pods per plant and weight of 100 seeds under this treatment. This might be the fact that excess assimilates stored in the leaves and later translocated into

Table 2 : Effect of sulphur and phosphorus levels on yield attributes and yield of greengram

Treatments	Number of pods per plant	Number of grains per pod	Weight of 100 grains (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
Sulphur (kg ha^{-1})					
$S_{0\ (00)}$	17.47	7.89	3.59	674	1223
$S_{1\ (10)}$	18.91	8.35	3.81	708	1354
$S_{2\ (20)}$	19.38	8.57	3.84	755	1400
$S_{3\ (30)}$	20.47	8.66	4.07	819	1551
S.E. ±	0.36	0.27	0.06	11	36
C.D. (0.05)	1.04	NS	0.16	31	104
Phosphorus (kg ha^{-1})					
$P_{0\ (00)}$	16.93	7.99	3.59	664	1234
$P_{1\ (20)}$	18.10	8.15	3.79	720	1290
$P_{2\ (40)}$	20.68	8.54	3.91	768	1442
$P_{3\ (60)}$	20.83	8.79	4.03	814	1563
S.E. ±	0.36	0.27	0.06	11	36
C.D. (0.05)	1.04	NS	0.16	31	104
C.V. (%)	6.49	11.05	5.05	5.07	8.99

seeds at the time of senescence, ultimately led to higher seed yield.

A significant increase in straw yield was also noticed due to application of phosphorus up to 60 kg P_2O_5/ha as compared to lower levels and control (Table 2). This might be due to 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. These findings corroborate the results of Singh and Sharma (2001), Choudhary *et al.* (2003) and Singh and Yadav (2004) in green gram.

Interaction effect of sulphur and phosphorus :

Combined application of 60 kg P_2O_5/ha along with 30 kg S/ha recorded significant increase in respect of grain and straw yields kg/ha. This indicates the synergistic effects of sulphur and phosphorus application in improving productivity of green gram. Similar, increase in yield due to combine application of sulphur and phosphorus were also reported by Majumdar *et al.* (2001) and Ijgude and Kadam (2008) in green gram.

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