

Effect of Phosphorus and Sulfur Levels on Growth and Yield of Green Gram (*Vigna radiata* L. Wilczek) under Guava (*Psidium guajava*) Based Agri-Horti System

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Received 3 February 2018; Accepted 20 February 2018; Published on 12 March 2018

Abstract A field experiment was conducted during *khariif* season of 2016 to study the effect of phosphorus and sulfur levels [control (T_1), 0 kg P_2O_5 ha⁻¹ + 15 kg S ha⁻¹ (T_2), 0 kg P_2O_5 ha⁻¹ + 30 kg S ha⁻¹ (T_3), 20 kg P_2O_5 ha⁻¹ + 0 kg S ha⁻¹ (T_4), 20 kg P_2O_5 ha⁻¹ + 15 kg S ha⁻¹ (T_5), 20 kg P_2O_5 ha⁻¹ + 30 kg S ha⁻¹ (T_6), 40 kg P_2O_5 ha⁻¹ + 0 kg S ha⁻¹ (T_7), 40 kg P_2O_5 ha⁻¹ + 15 kg S ha⁻¹ (T_8), 40 kg P_2O_5 ha⁻¹ + 30 kg S ha⁻¹ (T_9)] on growth and yield of green gram (*Vigna radiata* L. Wilczek) under guava (*Psidium guajava*) based agri-horti system. The growth and yield were significantly influenced by different levels of phosphorus and sulfur. The maximum height, number of branches plant⁻¹, dry matter accumulation plant⁻¹, nodules plant⁻¹, pods plant⁻¹, grains plant⁻¹, grain yield and stover yield recorded with 40 kg P_2O_5 ha⁻¹ (T_3) over 20 kg P_2O_5 ha⁻¹ (T_2) and control (T_1). This might be due to availability of adequate phosphorus coupled with satisfactory moisture condition in field resulted into improved nutrient supplying capacity of soil. Application of 30 kg P_2O_5

ha⁻¹ (S_3) proved significantly superior to the 15 kg P_2O_5 ha⁻¹ control (S_1) as sulfur might have helped in increasing the photosynthetic activity of plant. It is concluded that significant improvement in growth characters, yield parameters and yield were recorded with the application of 40 kg P_2O_5 ha⁻¹ and 30 kg P_2O_5 ha⁻¹ under guava based agri-horti system.

Keywords Green gram, Growth parameter, Phosphorus, Sulfur level, Yield.

Introduction

Agroforestry, where multipurpose trees are grown in combination with crops and or animals for meeting of diversified needs of farm and farmer, plays an important role in conserving resource base with increasing overall production. Country like India, where more than 50% of land is degraded both by physically and chemically with more than 60% of land is under rainfed therefore, adoption of agroforestry have great scope. Farmers prefer agroforestry system for account of short gestation period, regular income, risk cover and aesthetic value (Anonymous 2012). Fruit trees are integral part of agroforestry system and guava is one of them, having high yield potential, ability to grow in medium to light textured soils with drought with standing characters. Growing of short duration crop in agroforestry utilizes all resources efficiently, besides

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maintaining soil properties. Among short duration crops, green gram is most preferred crop.

Green gram is the most important pulse crop in India, grown predominantly under rainfed conditions. It is a protein rich staple food and supplies protein requirement of vegetarian population of the country. In addition to being an important source of human food and animal feed, green gram also plays an important role in sustaining soil fertility by improving soil physical properties and fixing atmospheric nitrogen. Proper nutrient management gives synergetic effect on yield and yield parameters of green gram. Among all nutrients, phosphorus and sulfur plays vital role in growth and development of green gram.

The phosphorus influences the photosynthesis, biosynthesis of protein and phospholipids, nucleic acid synthesis, membrane transport and cytoplasmic streaming. Increased availability of phosphorus owing to its application in soil improved the nutrient availability status resulting in greater uptake. Sulfur deficiency in crop is gradually becoming widespread due to continuous use of sulfur free fertilizers, high yielding crop varieties, intensive multiple cropping coupled with higher productivity.

Materials and Methods

The experiment was carried out at the agricultural research farm, Rajiv Gandhi South Campus, Banaras Hindu University, Barkachha, Mirzapur (UP) under guava based agri-horti system which is situated in Vindhyan region of district Mirzapur during *kharif* (rainy) season of 2016. The experimental site was located on 25° 10' N latitude 82° 37' E longitudes and an altitude of 427 meters above mean sea level. The predominant soil in the experimental field was sandy clay loam classified as inceptisol (*Typic ustochrept*) in texture, slightly acidic in reaction (pH 5.8), low in organic carbon content (0.36 kg/ha) and medium in available P and K contents. During the crop season total rainfall received was 513.70 mm, received during Standard Meteorological Weeks (SMW). The mean maximum temperature during the crop growth season ranged from 30.21-35.12°C whereas, mean minimum temperature ranged between 20-26-26.35 °C. The rela-

tive humidity varied between 46.32-96.57% respectively. The experiment was laid out in a randomized block design (factorial), where agri-horticultural system i.e. guava (*Psidium guajava*) was assigned. There were 9 treatments combination comprising one control treatment i.e. control (T₁), 0 kg P₂O₅ ha⁻¹+15 kg S ha⁻¹ (T₂), 0 kg P₂O₅ ha⁻¹+30 kg S ha⁻¹ (T₃), 20 kg P₂O₅ ha⁻¹ + 0 kg S ha⁻¹ (T₄), 20 kg P₂O₅ ha⁻¹ + 15 kg S ha⁻¹ (T₅), 20 kg P₂O₅ ha⁻¹ + 30 kg S ha⁻¹ (T₆), 40 kg P₂O₅ ha⁻¹ + 0 kg S ha⁻¹ (T₇), 40 kg P₂O₅ ha⁻¹ + 15 kg S ha⁻¹ (T₈), 40 kg P₂O₅ ha⁻¹+30 kg S ha⁻¹ (T₉) and each treatment was replicated thrice. In alleys of guava agri-horti system, certified seed mung bean, Malviya Jankalyani (HUM-16) was sown on August 29, 2016. Plot size of guava agri-horti system where, gross plot size 2.7 m × 2.5 m and net plot size 2.2 m × 2.0 m, respectively. Relatively higher seed rate (20 kg ha⁻¹) of mungbean was sown at 5 cm depth in open furrows made with a manual single row drill at a row spacing of 30 cm and plant to plant spacing 15 cm, and immediately covered with soil. All the doses of nitrogen, phosphorus and sulfur were applied just before sowing according to the treatment using diammonium phosphate (DAP) and elemental sulfur. Fertilizers were applied in band 4-5 cm below the surface. Crop was harvested from 21-24 October, 2016. The observations on growth parameters such as plant height, number of branches plant⁻¹, dry matter accumulation plant⁻¹, were recorded at 20, 40 DAS and at harvest stage while nodules plant⁻¹, were recorded at 40 DAS and at maturity. The observations on yield parameters and yield were recorded at physiological maturity.

Results and Discussion

Growth parameters

Different phosphorus levels markedly increased growth parameters, viz. plant height, number of branches plant⁻¹, dry matter accumulation plant⁻¹ and nodules plant⁻¹ (Table 1). Application of 40 kg P₂O₅ ha⁻¹+ 30 kg S ha⁻¹ proved significantly superior to rest of the treatments in respect of plant height, number of branches plant⁻¹ dry matter accumulation plant⁻¹ which was statistically at par with 40 kg P₂O₅ ha⁻¹ + 15 kg S ha⁻¹ at all the stages of mungbean. Adequate

Table 1. Effect of phosphorus and sulfur levels on growth attributes.

Treatment	Plant height (cm)	Number of branches plant ⁻¹	Drymatter accumulation (g plant ⁻¹)	Root nodules plant ⁻¹
Phosphorus levels (kg ha ⁻¹)				
0	33.80	2.20	2.62	5.58
20	36.42	3.44	2.93	6.12
40	36.54	4.10	3.44	6.63
SE m±	2.26	0.34	0.35	0.64
LSD (p=0.05)	6.79	1.03	1.05	1.93
Sulfur levels (kg ha ⁻¹)				
0	33.20	2.71	2.35	5.45
15	36.65	3.32	3.17	6.08
30	36.92	3.71	3.46	6.80
SE m±	2.26	0.34	0.35	0.64
LSD (p=0.05)	6.79	1.04	1.05	1.93

availability of phosphorus, coupled with satisfactory moisture condition in field might have improved nutrient supplying capacity of soil. Phosphorus is a major component of compound whose function relate to growth, root development, flowering and ripening (Sompong et al. 2010). Sulfur application greatly influences chlorophyll synthesis, carbohydrate as well as protein metabolism and finally results in improvement of growth characters contributing to higher dry matter accumulation in plants. These results are in close agreement with the findings of Singh et al. (2008) and Khatkar et al. (2007).

Yield and yield parameters

Application of 40 kg P₂O₅ ha⁻¹ + 30 kg S ha⁻¹ recorded significantly higher pods plant⁻¹ grains plant⁻¹, seed and stover yield. It was closely followed by 40 kg P₂O₅ ha⁻¹ + 15 kg S ha⁻¹ and proved significantly superior to rest of the treatments (Table 2). The results were accordance with Bhuiyan et al. (2008). The highest harvest index was found under 40 kg P₂O₅ ha⁻¹ + 30 kg S ha⁻¹ over rest of the treatments. This might be due to direct role of sulfur in enhancing the reproductive growth and the proportion of the reproductive tissue (inflorescences and pods) in total dry matter. This has also confirmed by Tripathi et al. (2011).

Table 2. Effect of phosphorus and sulfur levels on yield attributes and yield.

Treatment	Pods plant ⁻¹	Grains pod ⁻¹	Pod length (cm)	Grain yield (kg ha ⁻¹)	Stover yield (kg ha ⁻¹)
Phosphorus levels (kg ha ⁻¹)					
0	3.53	14.23	3.55	324.28	616.46
20	4.07	15.01	4.86	369.64	798.35
40	4.50	15.24	5.06	408.66	813.16
SE m±	0.41	0.47	0.33	4.51	147.09
LSD (p=0.05)	1.24	1.41	1.00	13.52	19.80
Sulfur levels (kg ha ⁻¹)					
0	3.65	13.94	3.80	351.05	609.05
15	4.10	14.84	4.58	369.39	790.12
30	4.35	15.70	5.10	382.14	828.80
SE m±	0.41	0.47	0.33	4.51	147.09
LSD (p=0.05)	1.24	1.41	1.00	13.51	19.80

Growth parameters of guava

Statistically non-significant differences observed in the growth parameters of guava might be due to shorter growth phase of green gram which could not realize the noticeable changes in the limited observation period.

Conclusion

On the basis of the findings of the present investigation, it can be concluded that application of 40 kg P₂O₅ ha⁻¹ + 30 kg S ha⁻¹ (T₉) resulted in maximum grain yield and stover yield and thus it could be profitable production under guava based agri-horti system under rain fed condition at R.G.S.C., B.H.U., Mirzapur (UP).

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