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Dhirendra Kumar Singh Bais
Student, Department of Agronomy, AKS University, Sherganj, Satna Madhya Pradesh, India

Dheerendra Prasad Chaturvedi
Teaching Associate, Department of Agronomy, AKS University, Sherganj, Satna Madhya Pradesh, India

Corresponding Author:
Dhirendra Kumar Singh Bais
Student, Department of Agronomy, AKS University, Sherganj, Satna Madhya Pradesh, India

Performance of different varieties and biofertilizer on growth, yield and quality of green gram (*Vigna radiata* L.)

Dhirendra Kumar Singh Bais and Dheerendra Prasad Chaturvedi

Abstract
An experiment was conducted at Instructional Farm, Department of Agronomy, Faculty of Agriculture, AKS University, Sherganj, Satna (M.P.) during *kharif* season of 2021-2022. The experiment consisted of randomize block design having Factorial arrangement in three replications. In this experiment, 12 treatment combinations including four different variety and biofertilizer *viz*., B_1- PSB, B_2- KSB, B_3- ZSB and B_4- Sagarika, while three green gram varieties were tested are V_1- Sikha (IPM-410), V_2- Samrat (PDM- 139) and V_3-Shital it was found that variety and biofertilizer significantly affected plant height, number of branches per plant, number of grains/pod, thousand grain weight, grain and Stover yield of green gram. Interaction effect between variety and biofertilizer significantly affect the plant height at 45 DAS and 60 DAS and number of branches per plant at 45 DAS and 60 DAS. Maximum plant height at 45 DAS and 60 DAS was recorded under treatment Shital (T_{12}, B_4V_3) with the respective values of 55.19 and 58.57 cm, respectively whereas, maximum number of branches per plant at 45 DAS and 60 DAS was recorded under the same treatment *i.e.*, 8.00 and 9.93, respectively. Similarly, Interaction effect of variety and biofertilizer on yield parameters such as number of pods per plant (20.73), seed yield per hectare (17.06 q) and straw yield per hectare (29.00 q) were recorded maximum with the application of variety and biofertilizer at the T_{12}, B_4V_3.

Keywords: Green geam, biofertilizer, plant, grains/pod, grain weight, stover yield

Introduction
Green gram (*Vigna radiata* L.) is the third most important food legumes grown and consumed in India and is also an important *kharif* legume of Madhya Pradesh. Pulses contain a high percentage of quality protein nearly three times as much as cereals (Upadhayay *et al*., 1999) [9]. Thus, pulses are cheaper source to overcome protein malnutrition among human beings. For vegetarian diet, pulses form the major source of protein. The pulses are known to improve the physical characteristics of soil through tap root system which opens the soil into the deeper strata and their ability to use atmospheric nitrogen through biological nitrogen fixation which is economically sound and environmentally acceptable.

India is the largest producer of pulses in the world, accounting for about 25% global share. Total pulse area in India is more than 29 million hectares and the production were 25.23 million tonnes at a productivity level of 841 kg/ ha in the year 2017-18 (Anonymous, 2018) [2]. Madhya Pradesh has been the major pulse producing state in the country. It ranked first both in terms of area (19.8%) and production (20.9%) of pulses in India. In Madhya Pradesh total pulse production was 5117.11 thousand tonnes from 5762.2 thousand hectares area with productivity of 888.08 kg/ha in 2015-16 (Anonymous, 2017) [1].

To enhance the productivity of this crop, use of balanced fertilization by application of NPK along with bio fertilizers *viz*., PSB, KSB, ZSB and Sagarika are of great importance. Green gram is a profuse modulating legume, does not require much of nitrogen. However, nitrogen plays an important role in various metabolic processes of the plant. Nitrogen application to legumes at lower doses in the initial stage is essential for vigorous start.

Phosphorus solubilizing bacteria play important role in phosphorus nutrition by enhancing its availability to plants through release from inorganic and organic soil P pools by solubilization and mineralization. Use of phosphorus solubilizing bacteria as inoculants increases phosphorus uptake. These bacteria also increase prospects of using phosphatic rocks in crop production. Greater efficiency of phosphorus solubilizing bacteria has been shown through co-inoculation with other beneficial bacteria and mycorrhiza (Khan *et al*., 2009) [5].

The modern varieties of green gram usually produce higher grain yield and yield component of green gram are markedly influenced by fertilizer levels. The farmers usually grow green gram without optimum dose of fertilizers; they hesitate to grow with higher doses. New varieties with optimum dose of fertilizers may increase the yield. The wide variations in yield attributing parameters persisted among the varieties obtained from the different parental origin. Attainments of particularly higher or lower yield attributing character among varieties are the genetically controlled phenomenon. Such variations in yield attributes among the green gram genotypes have also been observed by several research workers, (Bhowaland and Bhowmik, 2014) [3].

Materials and Methods

The experiment was conducted at the research plot of department of Agronomy, Faculty of Agriculture sciences and technology AKS University, Sherganj, Satna (M.P.) during the year 2021- 22. The experiment was conducted in randomize block design with Factorial concept with three replications. The treatments of four biofertilizers were B1- PSB, B2- KSB, B3- ZSB and B4- Sagarika, while three green gram varieties were evaluated are V1- Sikha (IPM-410), V2- Samrat (PDM- 139) and V3- Shital. The gross and net plot size was 5.0 m x 3.0 m and 4.0 m x 3.0 m, respectively. The experimental plots were fertilizers as per recommended dose.

Results and Discussion

The result shows that plant height, number of branches per plant, number of grains/pod, thousand grains weight, grain and Stover yield was influenced significantly due to different variety and biofertilizer.

The significantly highest plant height of green gram was recorded under the treatment combination consisting that application of bioorganic of Sagarika in combination with green gram variety of Shital (T_{12}, B_4V_3) with the respective values of 12.89, 55.19 and 58.57 cm at the growth stage of 30, 45 DAS and at 60 DAS, respectively proved significantly superior to rest of the treatments.

The significantly maximum number of branches per plant of green gram was recorded under the treatment combination consisting that application of bioorganic of Sagarika in combination with green gram variety of Shital (T_{12}, B_4V_3) with the respective values of 3.40, 8.00 and 9.93 at the growth stage of 30, 45 DAS and at 60 DAS, respectively proved significantly superior to rest of the treatments.

Biofertilizers are known to play an important role in increasing biological fixation of atmospheric nitrogen and enhance phosphorus and zinc availability to crop (Kumar (2012) [6]. The bio-fertilizers are safe, low cost and easy in application. The application of PSB treatments performed better in terms of plant height, number of branches, number of leaves at different intervals. This could be attributed to supply of additional phosphorus solubilization activities of the inoculated PSB biofertilizer. The positive effects of application of PSB in green gram on growth attributes have also been reported by Kudi and Singh (2016) [7]. Further, PSB is known to produce plant growth hormones such as gibberilic acid, indole acetic acid and cytokinin which might have favoured the growth of green gram.

The application of PSB recorded significantly higher values of dry matter accumulation, such increase in plant biomass might due to increase in P_2O_5 availability fixed by the PSB. This is due to the fact that PSB are also known to increase availability and solubility of phosphorus which might have helped in producing more growth promoting substances and fixing more phosphorus. Effectiveness of application of PSB in green gram crop may be due to synergistic activity of microorganism which increased availability of nitrogen and phosphorus to the crop. These results confirm the finding of Tyagi and Singh (2019) [8].

The significantly highest test weight of green gram was recorded under the treatment combination consisting that application of bioorganic of Sagarika in combination with green gram variety of Shital (T_{12}, B_4V_3) with the respective value of 38.34 g proved significantly superior to rest of the treatments.

The significantly highest grain yield per plant of green gram was recorded under the treatment combination consisting that application of bioorganic of Sagarika in combination with green gram variety of Shital (T_{12}, B_4V_3) with the respective value of 10.53 g proved significantly superior to rest of the treatments.

The significantly highest grain yield per hectare of green gram was recorded under the treatment combination consisting that application of bioorganic of Sagarika in combination with green gram variety of Shital (T_{12}, B_4V_3) with the respective value of 17.06 q/ha proved significantly superior to rest of the treatments.

The significantly highest stover yield of green gram was recorded under the treatment combination consisting that application of bioorganic of Sagarika in combination with green gram variety of Shital (T_{12}, B_4V_3) with the respective value of 29.00 q/ha proved significantly superior to rest of the treatments.

The higher yield attributes with the application of Sagarika might be due to the presence of bio-stimulant, which energizes the chlorophyll production, photosynthetic process, and thereby boosting vegetative growth. The results matched with Ishwarya *et al.* (2019) [4], who observed that in green gram, the seed soaking in 0.1% seaweed extract solution for 30 minutes along with the foliar application of seaweed extract 0.25% twice increased the plant height, root volume, number of branches significantly.

Table 1: Performance of different varieties and biofertilizer on growth, yield and quality of green gram (*vigna radiata* l.)

Treatment	Plant height (cm)	Number of branches/Plant	Test weight (g)	Seed yield per plant (g)	Seed yield (q/ha)	Stover yield (q/ha)
	Biofertilizer (B)					
B_1	53.88	5.53	34.07	8.39	12.55	25.30
B_2	52.25	4.73	32.07	7.43	10.37	21.56
B_3	49.34	3.93	28.49	5.24	5.97	14.79
B_4	57.39	6.64	36.74	9.77	15.85	28.84
S.Em±	1.11	0.51	0.85	0.36	0.78	1.40
CD	3.26	1.49	2.48	1.06	2.30	4.10
	Varieties (V)					
V_1	52.98	5.13	32.64	7.71	11.28	22.67
V_2	52.09	4.73	31.74	7.19	10.29	20.86
V_3	54.58	5.77	34.15	8.22	11.99	24.33
S.Em±	1.28	0.59	0.98	0.42	0.90	1.62
CD	3.77	1.72	2.87	1.23	2.65	4.74
	interaction effect between biofertilizers and green gram variety					
B_1V_1	52.74	5.60	34.21	8.42	12.28	23.91
B_1V_2	52.51	5.33	33.19	8.20	11.22	23.40
B_1V_3	56.38	5.67	34.80	8.54	14.14	28.58
B_2V_1	52.25	4.67	32.12	7.49	10.47	21.64
B_2V_2	52.04	4.47	31.58	7.13	10.11	20.62
B_2V_3	52.44	5.07	32.52	7.66	10.53	22.40
B_3V_1	50.05	4.13	27.60	5.10	6.03	16.30
B_3V_2	47.05	3.33	26.94	4.47	5.67	10.73
B_3V_3	50.91	4.33	30.93	6.16	6.22	17.34
B_4V_3	56.86	6.13	36.63	9.82	16.33	28.82
B_4V_3	56.74	5.80	35.24	8.97	14.17	28.70
B_4V_3	58.57	8.00	38.34	10.53	17.06	29.00
S.Em±	0.64	0.29	0.49	0.21	0.45	0.81
CD	1.33	0.61	1.01	0.43	0.94	1.68

Conclusion

Based upon this experiment it is concluded that application of Sagarika with green gram variety of Shital recorded the maximum and significantly higher grain yield (17.06q/ha), net returns (₹ 92211.00Rs/ha) and highest B: C ratio of 4.28: 1. Hence, it can be concluded that application of vermicompost @ 3 t/ha with green gram variety of Shital obtained B: C ratio >4.0, can be used as a remunerative strategy.

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