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Research Article

Influences of Varieties and Biofertilizer on Growth, Yield and Quality of Chickpea (*Cicer arietinum* L.)

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ABSTRACT

To study the effect of varieties and biofertilizers on growth and yield of chickpea, an experiment was conducted at instructional farm of department of Agronomy, Faculty of Agriculture, AKS University, Sherganj, Satna (M.P.) during rabi season of 2020-21. The experiment consisted of randomize block design having factorial arrangement with three replications. In this experiment, 12 treatment combinations including four chickpea varieties were tested are V_1- JG 63, V_2- JG 11, V_3- JG 14 and V_4- JG 36, while three levels of biofertilizers and treatments were B_1- Rhizobium, B_2- PSB and B_3- KSB application. Highest plant height (40.40 cm) and number of branches per plant (8.00) at 90 DAS while, number of pods per plant (34.73), number of grains per pods (2.60), seed index (20.70 g), grain yield (19.90 q/ha), stover yield (36.74 q/ha) and protein content (22.38 %) were recorded under the chickpea variety JG- 63 sown with biofertilizer of Rhizobium application.

Keywords: *Varieties, Biofertilizers, Tillers, Pods, Test weight, Stover yield.*

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is the second most important pulse crop after French bean (*Phaseolus vulgaris* L.). It is an annual legume which belongs to family fabaceae. It is popularly known as Gram or Bengal gram mainly grown during rabi season. Chickpea is an important winter season pulse crop of India and 68 per cent of total chickpea is mainly cultivated as rainfed crop. During 2017-18, chickpea production has been reported to be about 11.16 mt which is about 45% of the total pulse production in India from an area of 10.76 mha with the productivity of 1037 kg/ha (Anonymous, 2018). This makes our country a largest producer of chickpea in the world.

Among the various agronomic practices, suitable variety is the most important non-monetary input which helps in the maximization of yield under favourable environmental conditions.

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Production of crop also depends on the stability of variety. Stability is defined as the fixed production efficiency of a species under different environmental condition. Thus, stability in production efficiency of certain variety under changing conditions of environment is very important. Selection of variety for an environment would be easier by determining the stability, of a variety for an environment. Presently several high yielding chickpea varieties are available for Madhya Pradesh, but there is a need to test such varieties suitable to the Vindhya region.

To enhance the productivity of this crop, use of balanced fertilization by application of NPK along with biofertilizers *viz*., PSB, KSB, *Rhizobium* are of great importance. Bio-fertilizers or microbial inoculants are preparations containing living cells or latent cells of efficient strains of microorganisms used for soil and seed treatment that help the crop plants in uptake of nutrients by their interaction in the rhizosphere (Mishra et al., 2010) and have ability to convert nutritionally important elements from unavailable to available form through biological process. Atmospheric nitrogen must be processed or fixed in order to be used by the plants. The present study was planned to estimate the suitable chickpea variety and biofertilizers and its impact on growth and yield of chickpea.

MATERIALS AND METHODS

The experiment was carried out at instructional farm, Faculty of Agriculture, AKS University, Satna (M.P.) during *rabi* season 2020-21. The experiment was conducted in randomize complete block design having Factorial concept with three replications. Different bio-organics and chickpea varieties will be allocated to the plots as per treatments. Seed rate used as 80 kg/ha for transplanting with 30.0 x 10.0 cm distance. In this experiment four chickpea varieties were tested and these are V_1- JG 63, V_2- JG 11, V_3- JG 14 and V_4- JG 36, while three levels of biofertilizers and treatments were B_1- Rhizobium, B_2- PSB and B_3- KSB application. The gross and net plot size was 5.0 m x 3.50 m and 4.0 m x 3.0 m, respectively. The fertilizers grades were applied as per treatments. Full recommended dose of nitrogen, phosphorus and potassium at the rate of 20 kg N/ha, 60 kg P_2O_5/ha and 40 kg K_2O/ha, respectively were uniformly applied to each plot (except control plots) as basal dose at the time of sowing.

Required quantity of healthy, bold, unbroken and fully developed seeds of chickpea variety was inoculated separately with Azotobacter, PSB and ZSB as per treatment, before sowing of the crop. Chickpea seeds were inoculated with *Rhizobium*, PSB and KSB cultures as per treatments of @ 20 g/ kg seed by using 8 packets (200 g each packet) for 80 kg seed of chickpea needed for sowing one-hectare area. All the other agronomic practices were applied uniformly to all the treatments.

RESULTS AND DISCUSSION

Data regarding plant height and number of branches per plant are reported in Table 1. Statistical analysis of the data revealed that maximum plant height (40.40 cm) and number of branches per plant (8.00) at 90 DAS were recorded under the chickpea variety JG- 63 sown with biofertilizer of *Rhizobium* application.

At all the growth stage, variety JG- 63 produced significantly higher plant height and number of branches over the remaining varieties. The differences among the varieties with respect to branches formation may be owing to inheritance of genetic divergence of the varieties. Further, the differential behaviour among the varieties could be explained by the variation in their genetic makeup and their differential behavior under different climatic conditions. Govardhan et al. (2017) and Datta and Das (2018) also obtained similar variation in chickpea varieties.

Biofertilizers of *Rhizobium,* has the ability to fix atmospheric nitrogen in symbiotic association with crops. The amount of nitrogen fixed varies with the *Rhizobium* strain, the plant species and environmental conditions. The fixed phosphorus and potash in the soil can be solubilized by phosphate solubilizing

bacteria (PSB) and potassium solubilizing bacteria (KSB) which have the capacity to convert inorganic unavailable phosphorus and potash form to soluble forms through the process of organic acid production, chelating and ion exchange reactions and make them available to plants. Therefore, the use of biofertilizers in agricultural practice would not only offset the high cost of manufacturing inorganic fertilizers but would also mobilize insoluble in the fertilizers and soils to which they are applied (Navsare et al. (2018).

The application of *Rhizobium* significantly increased the dry matter accumulation. This might be attributed to increased availability of nitrogen due to nitrogen fixation by *Rhizobium*. The *Rhizobium* also enhanced availability of nutrients, production of growth promoting substances. Effectiveness of *Rhizobium* in chickpea crop may be due to synergistic activity of microorganism which increased availability of N and P to the crop. These results confirm the finding of Tyagi and Singh (2019) and Katiyar et al. (2020).

Statistical analysis of the data revealed that maximum number of pods per plant (34.73), number of grains per pods (2.60), seed index (20.70 g), grain yield (19.90 q/ha), stover yield (36.74 q/ha) and protein content (22.38 %).

This increase in yield and yield attributes of JG- 63 might be due to higher production efficiency which was reflected through improvement in different yield contributing characters. Differential yield potential due to different chickpea varieties was reported by Patidar and Singh (2018), Mondal and Sengupta (2019) and Sangeetha et al. (2020). Increase in grain yield and its parameters may be due to increase in the number of leaves which worked as an efficient photosynthesis structure and produced high amount of carbohydrates in the plant system. More number of branches which borne more number of flowers, which resulted higher fruits/plant and fruit yield and their attributes. Similar findings also reported by Chala et al. (2020). The variation in yield attributes of JG-63 variety may be due to genetic characteristics among different genotypes under present investigation. These findings are in agreement with the findings of Mondal and Sengupta (2019) and Sangeetha et al. (2020).

The uptake of a nutrient is a product of yield and its concentration in plant, the significant increase in total uptake of nitrogen, phosphorus and iron of variety JG- 63 might be the result of cumulative effect of higher content of these nutrients in grain and straw along with its higher yield. The conformity with findings of other workers like Rahman et al. (2020).

Application of *Rhizobium*, PSB, KSB significantly increased the grains per pod, effective branches per plant, filled grains per pod, grain yield, straw yield and biological yield. This could mainly be ascribed to the increased availability of the nitrogen to the plants through biological nitrogen fixation in rhizosphere by *Rhizobium* caused by the better root development due to more availability of P due to activity of PSB. Thus, the greater availability of nitrogen might have helped in vigorous plant growth, resulting in more dry matter accumulation and ultimately better flowering and ear head development. The increased yield probably may be resulted due to stimulation in germination and thereby increases in plant biomass by the nitrogen fixed by the *Rhizobium*. The results obtained here are in close agreement with the finding of Sahu and Chandrakar (2019).

The application of *Rhizobium* significantly increased the yield attributes and yield of chickpea. The increased availability of nitrogen due to *Rhizobium* application might have increased the growth, yield attributes and ultimately the yield due to increased photosynthetic rate, nitrogenase reductase activity, glutamine synthetase activity. These finding corroborate the results of Katiyar et al. (2020) and Salchame et al. (2020).

The application of *Rhizobium* significantly increased the nitrogen content in grain and straw, nitrogen uptake. The greater uptake of nitrogen is directly related with the increased concentration of protein content in

seed and straw and their higher yields. The results of the present investigation are in the line of finding observed by Salchame et al. (2020).

Table 1: Effect of Varieties and Bio-Fertilizers on Growth and Yield of Chickpea

Treatment	Plant height (cm)	Number of branches/ plant	Number of pods per plant	Number of grains/pod	Seed index (g)	Grain yield (q/ha)	Stover yield (q/ha)	Protein content (%)
	Effect of varieties							
V_1	39.28	6.69	32.53	2.04	19.48	19.20	36.39	21.80
V_2	28.41	3.09	25.42	1.13	14.04	12.25	29.75	17.90
V_3	36.65	5.27	29.51	1.56	17.63	17.26	35.77	20.43
V_4	33.99	4.18	27.60	1.33	16.49	14.34	34.21	19.17
S. Em±	1.83	0.46	1.14	0.22	0.80	0.74	0.74	0.35
C.D.	5.37	1.34	3.33	0.64	2.35	2.17	2.18	1.02
	Effect of biofertilizers							
B_1	36.42	5.42	29.97	1.72	17.85	16.73	34.57	20.24
B_2	35.42	4.83	28.87	1.45	16.98	15.67	34.14	19.87
B_3	31.90	4.17	27.47	1.38	15.89	14.90	33.38	19.35
S. Em±	2.11	0.53	1.31	0.25	0.92	0.86	0.86	0.40
C.D.	6.20	1.55	3.84	0.74	2.71	2.51	2.52	1.18
	Interaction effect between varieties and biofertilizers							
V_1B_1	40.40	8.00	34.73	2.60	20.70	19.90	36.74	22.38
V_1B_2	32.60	3.67	26.93	1.20	15.73	12.89	30.09	18.00
V_1B_3	37.82	5.60	30.07	1.67	18.04	17.52	35.83	20.76
V_2B_1	34.85	4.40	28.13	1.40	16.94	16.58	35.64	19.84
V_2B_2	38.99	6.47	31.60	1.80	18.98	19.37	36.50	21.63
V_2B_3	31.97	3.27	26.60	1.13	14.54	12.46	29.65	17.91
V_3B_1	36.48	5.27	29.60	1.53	17.71	17.43	35.77	20.48
V_3B_2	34.25	4.33	27.67	1.33	16.70	13.43	34.65	19.47
V_3B_3	38.44	5.60	31.27	1.73	18.76	18.33	35.92	21.38
V_4B_1	20.65	2.33	22.73	1.07	11.83	11.41	29.52	17.79
V_4B_2	35.65	4.93	28.87	1.47	17.13	16.83	35.73	20.05
V_4B_3	32.86	3.80	27.00	1.27	15.85	13.01	32.34	18.20
S. Em±	1.06	0.26	0.66	0.13	0.46	0.43	0.43	0.20
C.D.	2.19	0.55	1.36	0.26	0.96	0.89	0.89	0.42

CONCLUSION

Based upon this experiment it is concluded that application of Rhizobium biofertilizer with chickpea variety of JG- 63 recorded the maximum and significantly higher grain yield (19.90 q/ha), net returns (₹ 81224.00 Rs/ha) and highest B: C ratio of 3.17: 1. Hence, it can be concluded that application of Rhizobium biofertilizer with chickpea variety of JG- 63 obtained B: C ratio >3.0.0, can be used as a remunerative strategy.

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Conflict of Interest

The author(s) declares no conflict of interest.

Author Contributions

Shivani Mhaske was involved in data collection, analysis, interpretation and writing first draft of the manuscript. D.P. Chaturvedi was involved in revision and final compilation of the manuscript.

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