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Chickpea *(Cicer arietinum* L.) growth and yield in response to organic manures and biofertilizers

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ABSTRACT

The present investigation was carried out to find out the response of organic manures and biofertilizer on growth and yield of chickpea (*Cicer arietinum* L.). The field experiment was conducted during rabi season, 2021-22 at Crop Research Centre of School of Agricultural Sciences, Shri Guru Ram Rai University, Pathribagh, Dehradun, Uttarakhand. The experiment was carried out in randomize block design with 8 treatments and 3 replications. The investigation revealed that the performance of chickpea was significantly influenced by application of organic manures vermicompost. Among all the treatments, T_3: Vermicompost (5t/ha) was found best with respect to plant height (62.0 cm), dry matter accumulation per plant (30.66 g), number of root nodules/plant (24.47), test weight (25.21 g/100 seeds), number of pods per plant (50.14), number of grains per plant (58.13) and grain yield (1935.22 kg/ha). Based on overall performance, it can be concluded that application of organic manure (Vermicompost) can be recommended for efficient nutrients use efficiency and achieving maximum growth, nodulation and grain yield of chickpea.

Key words: *Chickpea, Organic manures, Biofertilizer, Yield*

Introduction

Chickpea *(Cicer arietinum* L.) is most important *Rabi* pulse, which is self-pollinated legume crop, belongs to Fabaceae family, sub family faboideae. It is a diploid species with a chromosome number 2n = 16. Chickpea is known by its different names like Bengal gram in English and Chana in Hindi. It is a crucial source of protein for vegetarians and is becoming more vital to deal with the problem of protein and energy deficiencies (Prasad *et al.,* 2014). Chickpea contain 16.4-31.2% protein, 3.0% fibre, 38.1-73.3% carbohydrates, 1.6-9.0% cellulose, 0.2% Ca, 0.3% P, 3.0% ash, vitamins (C and B) and minerals (Mg, Zn, K, Fe) (Huda *et al.,* 2003 and Ozer *et al.,* 2010). Citric and malic acids present in its leaves are beneficial for the stomach. It aids in lowering the amount of cholesterol in the blood. It is used to prepare a variety of snacks and desserts. As a green vegetable, fresh green seeds are consumed. Globally, it is cultivated on 14.84 million ha areas, 15.08 million tonnes production, and produces a median of 10.16 q ha^{-1} (FAOSTAT, 2020). It is grown in India over an area of 9.63 million ha, producing 11.91 million tonnes, and yielding 10.41 q ha^{-1} (DoA, C and FW, 2020-21). After Madhya Pradesh, Rajasthan,

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and Maharashtra, Uttar Pradesh is in 4th place as a result of area (0.57 million ha), production (0.53 million tonnes), and average productivity (930 kg ha^{-1}) (Agriculture Statistics at a Glance, GoI, 2021). The use of ever-increasing amounts of agrochemicals to increase agricultural production not only degrades the quality of agricultural products, but also reduces production, thereby decreasing farmers' income per capita. Presently, the excessive use of agrochemicals is contaminating our soil and water, posing a threat to the present and future human and animal populations. There is an imperative need to reduce the use of agrochemicals through the application of organic manures, particularly FYM and vermicompost, which also improves soil health. (Babalad *et al.,* 2009). By optimising the crop's nutrient needs at various growth stages, crop productivity can be increased under an organic production system. Organic systems rely on organic matter management to increase soil fertility and productivity (Naik *et al.,* 2014). Biofertilizers are carrier-based formulations with viable beneficial microorganisms for seed or soil application, enhancing soil fertility and plant growth by increasing rhizosphere microbial activity. Soil fertility is improved by fixing atmospheric nitrogen, solubilizing insoluble soil phosphates, and releasing plant development chemicals (Venkatashwarlu, 2008). Rhizobium inoculation improved nodulation and seed production by up to 35% (Bhuiyan *et al.,* 1998). Innoculation with *Rhizobium* enhanced chickpea seed yields by 9.6-27.9%, according to Gupta and Namdeo (1996b). Phosphate solubilizing bacteria (PSB) play an important role in making phosphorus available to crop plants. Phosphorus is an important major nutrient which determines the productivity of chickpea in addition to N and K. It also has beneficial influence on plant growth, seed yield and quality as they fix large quantity of biological nitrogen (Ravindra *et al.,* 2007). The combination of *Rhizobium* and PSB improves chickpea production, nodulation, plant height, and seed protein. *Rhizobium* and PSB are crucial for N_2-fixation and P-solubilization. Therefore, a study was envisaged to find out the effect of different organic manures and biofertilizer on growth and yield of chickpea.

Materials and Methods

Experimental site

The field experiment was conducted at Crop Research Centre of Shri Guru Ram Rai University, Dehradun, Uttarakhand, during *Rabi* season of 2021-2022. The experimental soil was sandy loam in texture, neutral in soil reaction (pH 7.1), high in organic carbon (2.22%), very low in available nitrogen (198 kg/ha), high in available phosphorus (20.5 kg/ha), low in available potassium (173.2 kg/ha).

Treatments

The experiment was conducted in Randomized Block design (RBD) with eight treatments {T_1= Control, T_2= FYM 10 t/ha, T_3= Vermicompost 5 t/ha, T_4= *Rhizobium* @ 20g/kg seeds, T_5= PSB, T_6= *Rhizobium* (50%) + PSB (50%), T_7= Vermicompost (50%) +*Rhizobium* (25%) + PSB (25%),T_8= FYM (50%) +*Rhizobium* (25%) + PSB (25%)} and three replications.

Observations and statistical analysis

The observations of growth and yield parameters were taken from randomly selected 5 plants from each treatments plot. The experimental data was analysed statistically by analysis of variance (ANOVA) suing SPSS software program. The significant difference of treatment was determined by using F-test.

Results and Discussion

Plant height (cm)

The plant height shows non-significant difference among the treatments at 45 days after sowing (DAS), while it was significant at 90 days after sowing (DAS) and harvesting. The plant height recorded maximum at 90 DAS (55.12 cm) and harvesting (62.00 cm) with application of vermicompost, *i.e.* T_3. The increased plant height of chickpea might be due to application of suitable amount of organic nutrient which results higher growth and development of plants. The minimum plant height was recorded at 90 DAS (42.32 cm) and Harvesting (47.22 cm) with control (T_1) means no any application of nutrient. These findings are also in agreement with the findings of Chauhan, (2012).

Dry matter accumulation (g/plant)

As the crop growth advanced, dry matter accumulation per plant increased steadily till harvest stage. Significant results were observed in all the stages of growth. Dry matter accumulation was recorded highest with T_3: Vermicompost at 45 DAS (5.43 g), 90 DAS (16.38 g) and at harvest (30.66 g). The low-

est dry matter accumulation was observed with control treatment at 45 DAS (1.52 g) and at harvest (13.62 g). Judicious use of FYM and combined use of Vermicompost increased vegetative growth of plant, the similar results were also reported by Mahatele *et al.* (2011) and Singh *et al.* (2010).

Number of root nodules/plant

The number of root nodules/plant was found significant in both the growth stages *i.e.* at 45 DAS and 90 DAS. Maximum number of root nodule was found with T_3: Vermicompost at 45 DAS (8.47) and 90 DAS (24.47), which was at par with T_2 (farm yard manure) and T_7: Vermicompost+ *Rhizobium*+ PSB).T_1 control recorded the minimum number of root nodules (3.62) at 45 DAS and (12.34) at harvest.Use of organic manures (FYM and Vermicompost) highly increased nodule per plant. These findings were supported by Mohammadi *et al.* (2010), and Tagore *et al.* (2013).

Number of total pods per plant

The data revealed that the significantly maximum number of pods per plant was recorded under T_3: Vermicompost (50.14) compared to all the other treatments. $T_3$was found statistically at par with T_2: FYM (46.85) and T_7: Vermicompost + *Rhizobium* + PSB (45.55). Control showed the lowest result (30.26). These results corroborate with the finding of Sharma (2001).

Number of grains per plant

The maximum number of total grains per plant (58.13) was recorded under T_3: Vermicompost (58.13), as compared to all the other treatments except T_2: FYM (57.55) and T_7:Vermicompost+ *Rhizobium*+ PSB (55.04) respectively, which was statistically at par. Whereas the minimum number of grains per plant was recorded under the treatment T_1: Control (43.63). The present results are in agreement with those of Jati (2004) and Chouhan *et al.* (2012).

Table 1. Effect of various treatments on growth parameters of chickpea at various stages

Symbol	Plant Height (cm)			Dry matter production per plant (g)			Number of nodules per plant	
	45 DAS	90 DAS	At harvest	45 DAS	90 DAS	At harvest	45 DAS	90 DAS
T_1	20.17	42.32	47.22	1.52	11.76	13.62	3.62	12.34
T_2	26.32	52.18	58.00	4.87	14.67	27.43	7.93	23.88
T_3	27.12	55.12	62.00	5.43	16.38	30.66	8.47	24.47
T_4	22.27	44.37	51.18	2.55	13.15	23.13	5.60	21.65
T_5	20.21	44.52	49.11	2.08	11.51	15.48	4.86	18.54
T_6	23.34	45.62	50.02	2.34	11.59	18.83	5.44	20.23
T_7	24.21	48.80	53.03	4.12	14.21	25.22	7.34	23.54
T_8	23.62	49.61	52.00	3.39	13.51	24.68	6.43	23.21
SEm±	1.604	0.544	0.664	0.529	0.522	1.023	0.760	1.072
CD(P=0.05)	NS	1.665	2.035	1.619	1.597	3.134	2.328	3.282

Table 2. Effect of various treatments on yield parameters of chickpea at various stages

Symbol	No. of total pod/ plant	Total no. of grains/ plant	Test weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest Index (%)
T1	30.26	43.63	13.32	746.92	1451.94	35.98
T2	46.85	57.55	24.17	1863.10	2405.12	43.65
T3	50.14	58.13	25.21	1935.22	2652.33	42.18
T4	39.11	49.96	17.88	1561.42	2173.26	41.80
T5	34.39	44.97	13.85	1072.93	1841.31	38.83
T6	37.50	46.29	15.05	1435.61	1928.12	42.67
T7	45.55	55.04	21.31	1628.50	2197.61	42.50
T8	42.72	52.17	20.25	1767.12	2324.45	43.18
SEm±	0.737	0.864	0.678	65.933	95.543	0.545
CD(P=0.05)	2.256	2.647	2.076	201.924	292.607	1.670

Test weight (100 grain weight)

The test weight of grain was influence by organic and biofertilizer sources. The significantly maximum test weight was recorded under T_3: Vermicompost (25.21 g) as compared to all the other treatments except T_2: FYM (24.17 g) and T_7: Vermicompost + *Rhizobium*+ PSB (21.31 g) respectively, which was statistically at par with each other, whereas the minimum test weight was recorded under the T_1: Control (13.32 g). The similar findings was observed by Tagore *et al.* (2013).

Grain Yield (kg/ha)

The data on grain yield kg per hectare revealed that the response of organic and biofertilizer sources of nutrition on grain yield per ha of chickpea was found significantly high under T_3: Vermicompost (1935.22 kg/ha), which was at par with T_2: FYM (1863.10 kg/ha) T_8: FYM + *Rhizobium* + PSB(1767.12 kg/ha) and T_6: *Rhizobium* + PSB (1628.50 kg/ha) respectively. Whereas, the significantly lowest grain yield per ha was recorded under T_1: Control. Similar findings were observed by Patil *et al.* (2012).

Straw Yield (kg/ha)

The data pertaining in the Table revealed that the straw yield showed significant difference in all the treatments. The maximum straw yield was found with T_3: Vermicompost (2652.33 kg/ha) which was statically at par with T_2: FYM (2405.12 kg/ha) and T_8: FYM + *Rhizobium*+ PSB(2324.45 kg/ha) respectively. The minimum straw yield was recorded with T_1: Control (1451.94 kg/ha).

Harvesting Index (%)

The response of organic manures and biofertilizer on growth and yield of chickpea crop did influence the harvesting index. Relatively, more harvest index was observed in the treatment T_2: FYM (43.65%) than others. Comparatively, lower harvest index was observed in the T_1: Control (35.98%).

Conclusion

Biofertilizers and organic manures are more efficient, cost-effective, and environmentally benign than chemical fertilizers. They reduce the use of synthetic fertilizers in chickpea cultivation by maximizing the use of available nitrogen (N) and other nutrients. Protect the environment from the detrimental effects of chemical fertilizers and enhance soil fertility by maintaining the population of beneficial microorganisms. The combined application of biofertilizers increases the efficacy of chickpea growth and yield.

Conflict of Interest - None

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