

Original Research Article

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## Effect of Fertility Levels and Bio-Fertilizers on Growth and Yield of Chickpea (*Cicer arietinum* L.)

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### ABSTRACT

#### Keywords

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A field experiment was carried to Effect of fertility levels and bio-fertilizers on growth and yield of chickpea (*Cicer arietinum* L.) during 2018-19 at the Department of Agriculture, Vivekananda Global University, Jaipur, Rajasthan. The application of RDF 100 % + *Rhizobium* + PSB recorded maximum plant population, plant height, dry matter, number of pods/plant, number of grain/pod, grain weight/plant, 100- grain weight, grain and straw yield which was closely followed by application of RDF 75 % + *Rhizobium* + PSB and found superior to remaining all other treatments. Thus, for growing chickpea crop the application of RDF 100 % + *Rhizobium* + PSB were found most suitable.

### Introduction

Chickpea (*Cicer arietinum* L.) is an important pulse crop with synonym Bengal gram, garbanzo (Spanish), chana (Hindi) and chanaka (Sanskrit). Chickpea (*Cicer arietinum* L.) is the largest produced food legume in South Asia and the third largest produced food legume globally, after the common bean (*Phaseolus vulgaris* L.) and field pea (*Pisum sativum* L.). India is the largest chickpea producing country accounting for 64% of the global chickpea production. The other major chickpea producing countries include Pakistan, Turkey,

Iran, Myanmar, Australia, Ethiopia, Canada, Mexico and Iraq. It is grown in an about 30% of the national pulse acreage which contributes to about 38% of national pulse production in India. Chickpea cultivation area in India is 9.92 m ha production is 9.88 m t and productivity 0.99 t ha<sup>-1</sup> (FAO, 2017). In Rajasthan cultivated area 13.72 lakh ha, production 12.10 lakh t and productivity 882 kg ha<sup>-1</sup>.

Pulses occupy a very important place in Indian diet because they constitute the major source of protein to the predominantly vegetarian population. Nutritionally,

Chickpea is relatively free from various antinutritional factors, has a high protein digestibility, and is richer in phosphorus and calcium than other pulses. Because of its higher fat content and better fiber digestibility, chickpea holds good promise as a protein and calorie source for animal feed. Chickpea straw also has a forage value. Because of these diversified uses of the crop and its ability to grow better with low inputs under harsh edaphic factors, it is an important component of the cropping system of subsistence farmers in the Indian subcontinent.

Keeping in view the foresaid beneficial effects of symbiotic and free-living nitrogen fixing microbes, an attempt has been made to evaluate the associative effect of *Rhizobium* and *Azotobacter* on chickpea (*Cicer arietinum* L.). Besides these bacteria, phosphate solubilising microbes of different genus/species were also included in order to assess their effect on plant growth and yield under organic farming. The extensive use of chemical fertilizers in agriculture is currently under debate due to environmental concern and fear for consumer health. Consequently, there has recently been a growing level of interest among the people to develop and adopt eco-friendly sustainable agricultural practices. In this context, increasing and extending the role of biofertilizers may reduce the need of chemical fertilizers and there by decrease adverse environmental effects (O'Connell 1992). Based on the above perspectives, the present investigation was undertaken to find out the effects of the bio-organics and chemical fertilizers on the performance of chickpea.

### Materials and Methods

A field experiment was conducted during winter (*rabi*) season of 2018-19 at Research Farm, Vivekananda Global University, Jaipur, situated at 075°88'99" E longitude and

26°81'17" N latitude at an altitude of 431 meters above mean sea level in Jaipur district of Rajasthan. This region falls under agro-climatic zone III A of Rajasthan (Semi-arid Eastern Plain Zone). The total rainfall received during the crop season was 16.6 mm. The experiment consisting 8 treatment combinations and was laid out in Randomized Block Design with three replications each. T<sub>1</sub> RDF 75%, T<sub>2</sub> RDF 100%, T<sub>3</sub> RDF 100% + PSB, T<sub>4</sub> RDF 100% + Rhizobium, T<sub>5</sub> RDF 100% + Rhizobium + PSB, T<sub>6</sub> RDF 75% + PSB, T<sub>7</sub> RDF 75% + Rhizobium, T<sub>8</sub> RDF 75% + Rhizobium + PSB. Chickpea (RSG-888) was sown manually using a seed rate of 80 kg ha<sup>-1</sup> with 30 cm row spacing. Crop was grown in irrigated conditions and it was not much affected by the incidence of pest and diseases. The economics was calculated by considering the sale price of chickpea and cost of cultivation during 2019. Data collected on various parameters of crop were subjected to statistical analysis to draw valid conclusion.

### Results and Discussion

Chickpea plants exhibited significant responses to various fertility levels and bio-fertilizers in respect of growth and yield parameters (Table 1). Application of T<sub>5</sub> (RDF 100 % + Rhizobium + PSB) were found significantly superior in improving the growth parameters like plant population, plant height at harvest, dry matter accumulation at 30, 60, 90 DAS and at harvest, number of pods plant<sup>-1</sup>, number of grains pod<sup>-1</sup> and grains weight plant<sup>-1</sup> which was statistically at par with T<sub>4</sub> (RDF 100 % + *Rhizobium*) and the lowest recorded in T<sub>1</sub> (RDF 75 %). Similarly, treatments T<sub>5</sub> was statistically at par with T<sub>3</sub> (RDF 100 % + PSB) and T<sub>8</sub> (RDF 75 % + *Rhizobium* + PSB). While, treatments T<sub>5</sub> was significantly superior with treatments T<sub>2</sub> (RDF 100 %), T<sub>6</sub> (RDF 75 % + PSB), T<sub>7</sub> (RDF 75 % + *Rhizobium*) and T<sub>1</sub> (RDF 75 %).

Plant height showed marked variation due to the combined application of inorganic fertilizers and organic manure i.e. *Rhizobium* and *PSB*. The basal application of chemical fertilizers meets the nutritional requirement of crop for proper establishment and growth during the initial period. The results are in agreement with the findings of Sripriya *et al.*, (2005) and Solaiman *et al.*, (2012). The significant effects on these parameters as a consequence of *Rhizobium* and *PSB* in conjugation with chemical fertilization are attributed to the favorable nutritional status of soil resulting into increased biomass production of the crop. The observation made by Singh *et al.*, (2015) also recorded marked differences in dry matter accumulation in chickpea in response to integrated nutrient management. Significantly higher total dry matter accumulation at different plant growth stages was recorded with the application of Data accumulated in connection dry matter accumulation at different stages, the maximum dry matter accumulation (0.50) was found with T<sub>5</sub> (RDF 100 % + *Rhizobium* + *PSB*) which remained at par with T<sub>4</sub> (RDF 100 % + *Rhizobium*) and the lowest recorded in T<sub>1</sub> (RDF 75 %). The improvement in growth attributing parameters directly supports the development of yield attributing characters. Therefore, the better assimilation of photosynthate and their partitioning into developing pod clusters might have taken place that improved yield attributing characters like pods plant<sup>-1</sup> and seeds pod<sup>-1</sup>. Similarly, Chandra and Pareek, (2015), Solanki *et al.*, (2015) and Singh *et al.*, (2018), Yadav *et al.*, (2017) also reported the improved yield attributes of chickpea with integration of synthetic fertilizers and organic manures.

The 100-grain weight, grain and straw yield recorded at harvest is presented in Table 2. The data shows that there was a significant effect of different treatments on the 100-grain

weight, grain and straw yield. Significantly the highest 100-grain weight, grain and straw yield was registered under the T<sub>5</sub> [RDF 100 % + *Rhizobium* + *PSB*] followed by T<sub>4</sub> (RDF 75 % + *Rhizobium* + *PSB*), T<sub>1</sub> (RDF 75 %) recorded the minimum. Similarly, treatments T<sub>5</sub> was statistically at par with T<sub>3</sub> (RDF 100 % + *PSB*) and T<sub>8</sub> (RDF 75 % + *Rhizobium* + *PSB*). While, treatments T<sub>5</sub> was significantly superior with treatments T<sub>2</sub> (RDF 100 %), T<sub>6</sub> (RDF 75 % + *PSB*), T<sub>7</sub> (RDF 75 % + *Rhizobium*) and T<sub>1</sub> (RDF 75 %).

The proper mobilization of dry matter production towards the sink (seed yield) is an important factor for economic yield. The chickpea has more potential to translate assimilates towards economic yield due to response to applied inputs.

Significantly the highest grain yield was registered under the T<sub>5</sub> (RDF 100 % + *Rhizobium* + *PSB*) which was statistically similar with T<sub>4</sub> (RDF 75 % + *Rhizobium* + *PSB*). While, T<sub>1</sub> (RDF 75 %) recorded the minimum. This might be due to the fact of vigorous growth of plants and consequently higher biomass production of leaves. Similar findings were reported by Chandra and Pareek (2015).

The favorable growth parameters greatly influenced the yield attributes and consequently increased crop yield. Crop productivity is depending on two factors; firstly, structural material and secondly precursors of the materials. Precursors are soil nutrients exerted by the plants through their roots and primary photosynthates manufactured by green plant organs in the presence of light and carbon-di-oxide and it is the combination of photosynthesis and plant nutrients results in structural material representing the source and sink forms. Comparable findings were reported by Biswas *et al.*, (2015) and Singh *et al.*, (2015).

**Table.1** Effect of fertility and bio-fertilizers levels on growth and yield parameters of chickpea (*Cicer arietinum* L.)

Symbols	Treatments	plant population per plot		Plant height at harvest	dry matter accumulation (g plant <sup>-1</sup> )				Number of pods plant <sup>-1</sup>	Number of grain pod <sup>-1</sup>	Grains weight plant <sup>-1</sup> (g)
		25 DAS	At harvest		30 DAS	60 DAS	90 DAS	At harvest			
T <sub>1</sub>	RDF 75 %	84.60	83.94	36.72	0.34	1.70	3.21	2.20	29.75	1.53	153.54
T <sub>2</sub>	RDF 100 %	87.22	85.89	39.56	0.41	1.95	3.66	2.55	32.38	1.66	160.47
T <sub>3</sub>	RDF 100 % + PSB	98.33	97.00	46.98	0.46	2.29	4.24	2.95	38.28	1.92	163.78
T <sub>4</sub>	RDF 100 % + <i>Rhizobium</i>	98.62	97.62	47.12	0.47	2.30	4.25	2.96	38.40	1.93	167.61
T <sub>5</sub>	RDF 100 % + <i>Rhizobium</i> + PSB	102.24	101.24	50.12	0.50	2.43	4.52	3.15	40.84	2.05	171.84
T <sub>6</sub>	RDF 75 % + PSB	85.60	84.60	39.30	0.39	1.92	3.55	2.47	32.03	1.61	162.59
T <sub>7</sub>	RDF 75 % + <i>Rhizobium</i>	85.37	84.37	39.20	0.39	1.91	3.54	2.46	31.94	1.60	162.20
T <sub>8</sub>	RDF 75 % + <i>Rhizobium</i> + PSB	97.68	96.35	46.67	0.46	2.25	4.21	2.93	38.03	1.91	165.98
<b>SEm±</b>		3.20	2.57	2.01	0.02	0.09	0.16	0.11	1.36	0.08	3.33
<b>CD (P=0.05)</b>		9.72	7.81	6.11	0.05	0.26	0.47	0.33	4.14	0.24	10.11
<b>CV (%)</b>		6.25	6.33	7.28	7.92	8.23	8.94	9.02	8.42	5.42	6.12

**Table.2** Effect of fertility and bio-fertilizers levels on 100-seed weight, grain and straw yield of chickpea (*Cicer arietinum* L.)

Symbols	Treatments	100-seed weight (g)	Grain yield (kg ha <sup>-1</sup> )	Straw yield (kg ha <sup>-1</sup> )
T <sub>1</sub>	RDF 75 %	10.89	1528.1	2498.6
T <sub>2</sub>	RDF 100 %	11.21	1820.1	3198.5
T <sub>3</sub>	RDF 100 % + PSB	12.51	2108.4	4100.4
T <sub>4</sub>	RDF 100 % + Rhizobium	12.53	2114.5	3944.0
T <sub>5</sub>	RDF 100 % + Rhizobium + PSB	12.84	2249.3	4288.4
T <sub>6</sub>	RDF 75 % + PSB	10.95	1763.8	3129.1
T <sub>7</sub>	RDF 75 % + Rhizobium	10.93	1758.9	3156.6
T <sub>8</sub>	RDF 75 % + Rhizobium + PSB	12.44	2094.3	3876.9
<b>SEm±</b>		0.39	79.66	193.12
<b>CD (P=0.05)</b>		2.19	241.63	585.78
<b>CV (%)</b>		7.12	9.82	10.13

In conclusion after all the analysis study revealed that integrated nutrient management brought an additive effect in increasing growth, yield, quality and economics of chickpea crop. The highest seed and straw yield (2249.3 and 4288.4 kg ha<sup>-1</sup>), net returns (₹141073 ha<sup>-1</sup>) were obtained under the combined application of T<sub>5</sub> (RDF 100 % + *Rhizobium*+ PSB). Thus, for growing chickpea crop the application of T<sub>5</sub> (RDF 100 % + *Rhizobium* + PSB) were found most suitable.

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