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Effect of Liquid Biofertilizers on Growth, Yield of Chickpea (Cicer aeritinum L.)

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Abstract - Chickpea (*Cicer arietinum* L.) is an important pulse crop that contributes significantly to nutritional security and soil fertility through biological nitrogen fixation. However, its productivity is often constrained by poor soil fertility and imbalanced nutrient management. A field experiment was conducted during the Rabi season of 2025–26 at the Research Farm, Vivekananda Global University, Jaipur, Rajasthan, to evaluate the effect of liquid biofertilizers on the growth, yield, nutrient uptake, and economics of chickpea. The experiment was laid out in a Randomized Block Design with three replications and eleven treatments comprising different combinations of recommended fertilizer dose (RDF) and liquid biofertilizers (Rhizobium, PSB, and KSB). Results revealed that the application of 75% RDF along with liquid Rhizobium + PSB + KSB significantly improved growth and yield attributes of chickpea. The treatment recorded plant height of 58.16 cm at harvest, dry matter accumulation of 28.02 g plant^{-1}, 42.23 pods plant^{-1}, 1.69 seeds pod^{-1}, and a test weight of 178.10 g. It also produced a seed yield of 1495 kg ha^{-1}, which was statistically at par with 100% RDF (1531 kg ha^{-1}). The integrated use of liquid biofertilizers enhanced nutrient uptake, improved crop performance, and reduced fertilizer requirements by 25%. Therefore, application of 75% RDF combined with Rhizobium, PSB, and KSB can be recommended for sustainable and economical chickpea production.

Keywords: Chickpea, liquid biofertilizers, Rhizobium, PSB, KSB, nutrient uptake, yield, sustainable agriculture.

INTRODUCTION

Pulses are an essential component of sustainable agriculture and human nutrition, particularly in India, where they serve as an affordable source of protein, dietary fibre, vitamins, and minerals. Besides their nutritional value, pulses improve soil fertility through biological nitrogen fixation and contribute to sustainable cropping systems. However, pulse productivity remains low due to cultivation under rainfed conditions, poor soil fertility, nutrient deficiencies, and imbalanced fertilizer use.

Among pulse crops, chickpea (*Cicer arietinum* L.), popularly known as the “King of Pulses,” is one of the most important rabi legumes cultivated in semi-arid regions. Its grains contain 18–24% protein and are rich in carbohydrates, minerals, and vitamins. Chickpea also enhances soil health by fixing atmospheric nitrogen and improving soil organic matter. India is the largest producer and consumer of chickpea, yet productivity remains below potential due to inadequate nutrient management and declining soil fertility.

Liquid biofertilizers have emerged as an eco-friendly and cost-effective approach to improve nutrient availability, enhance biological nitrogen fixation, stimulate plant growth, and increase nutrient uptake. Their application can improve crop productivity, grain quality, and soil health while reducing dependence on chemical fertilizers.

MATERIAL METHODS

A field experiment was conducted during the *Rabi* season of 2025–26 at the Research Farm, Vivekananda Global University, Jaipur, Rajasthan, India (26°51′ N latitude, 75°47′ E longitude, and 390 m above mean sea level). The experimental site falls under the Semi-Arid Eastern Plain Zone (Agro-climatic Zone IIIA) of Rajasthan. The soil of the experimental field was loamy sand in texture, alkaline in reaction (pH 8.1), low in organic carbon (0.24%) and available nitrogen (139.2 kg ha^{-1}), and medium in available phosphorus (58.5 kg ha^{-1}) and potassium (216 kg ha^{-1}).

The experiment was laid out in a Randomized Block Design (RBD) with three replications and eleven treatments comprising different combinations of recommended fertilizer dose (RDF) and liquid biofertilizers, namely Rhizobium, phosphate-solubilizing bacteria (PSB), and potassium-solubilizing bacteria (KSB). Chickpea variety CSJ-515 was sown on 20 October 2025 using a seed rate of 70 kg ha^{-1} with a spacing of 30 cm × 10 cm. Recommended doses of fertilizers were applied as basal, and all recommended agronomic and plant protection practices were followed throughout the crop growth period.

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Observations on growth parameters, yield attributes, grain and straw yield, nutrient uptake, and economics were recorded using standard procedures. The experimental data were subjected to analysis of variance (ANOVA), and treatment means were compared using the critical difference (CD) test at the 5 per cent level of significance.
The study was undertaken with the objectives to evaluate the effect of liquid biofertilizers on growth and yield of chickpea, assess their influence on nutrient uptake and quality, and determine the economic feasibility of different biofertilizer treatments.

RESULTS

Plant height (cm)

It is apparent from data that different treatments significantly influenced the plant height at all the growth stages. Results revealed that the treatment 75% RDF + Liquid (Rhizobium+PSB+KSB) recorded the maximum plant height of 20.79, 39.23 and 58.16 cm at 40, 80 and at harvest, respectively which was at par with 100% Recommended Dose of Fertilizers (RDF) recorded 21.06, 40.23 and 59.15 at 40, 80 and at harvest, respectively which proved significantly superior to control but statistically found similar to all other treatments except treatment control.

Table 1.0: Effect of liquid biofertilizers on plant height (cm) of chickpea at different stages

Treatments	At 40 DAS	At 80 DAS	At harvest
Control	14.77	22.62	30.72
100% Recommended Dose of Fertilizers (RDF)	21.06	40.23	59.15
Liquid Biofertilizer (Rhizobium+ PSB+KSB) alone	16.45	27.23	37.89
75% RDF	17.32	30.53	40.35
75% RDF+ Liquid Rhizobium	18.79	36.98	52.62
75% RDF + Liquid PSB	18.47	33.86	43.68
75% RDF + Liquid KSB	17.71	31.13	42.26
75% RDF + Liquid (Rhizobium+PSB)	20.50	38.62	56.79
75% RDF + Liquid (Rhizobium+KSB)	19.41	37.56	55.94
75% RDF + Liquid (PSB+KSB)	19.12	37.44	53.68
75% RDF + Liquid (Rhizobium+PSB+KSB)	20.79	39.23	58.16
SEm±	0.42	1.22	2.70
CD (P=0.05)	1.25	3.61	7.98

EFFECT OF LIQUID BIOFERTILIZERS ON PLANT DRY MATTER ACCUMULATION (G PLANT^{-1}) OF CHICKPEA AT DIFFERENT STAGES

It is apparent from data that different treatments significantly influenced plant dry matter accumulation (g plant^{-1}). Results revealed that the treatment 75% RDF + Liquid (Rhizobium+PSB+KSB) recorded the maximum plant dry matter accumulation of 4.81, 9.81 and 28.02 (g plant^{-1}) at 40, 80 and at harvest, respectively which was at par with 100% Recommended Dose of Fertilizers (RDF) recorded 4.91, 4.89 and 28.85 at 40, 80 and at harvest, respectively which proved significantly superior to control but statistically found similar to all other treatments except treatment control.

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Table 2.0: Effect of liquid biofertilizers on plant dry matter accumulation (g plant^{-1}) of chickpea at different stages

Treatments	At 40 DAS	At 80 DAS	At harvest
Control	2.07	6.96	16.12
100% Recommended Dose of Fertilizers (RDF)	4.91	9.89	28.85
Liquid Biofertilizer (Rhizobium+ PSB+KSB) alone	2.78	7.76	19.54
75% RDF	3.03	8.03	20.35
75% RDF+ Liquid Rhizobium	4.26	9.26	26.14
75% RDF + Liquid PSB	3.36	8.36	25.97
75% RDF + Liquid KSB	3.24	8.24	22.36
75% RDF + Liquid (Rhizobium+PSB)	4.74	9.74	27.60
75% RDF + Liquid (Rhizobium+KSB)	4.68	9.68	26.69
75% RDF + Liquid (PSB+KSB)	4.34	9.34	26.42
75% RDF + Liquid (Rhizobium+PSB+KSB)	4.81	9.81	28.02
SEm±	0.32	0.43	0.76
CD (P=0.05)	0.93	1.27	2.23

EFFECT OF LIQUID BIOFERTILIZERSON PLANT DRY MATTER ACCUMULATION (G PLANT^{-1}) OF CHICKPEA AT DIFFERENT STAGES

Effect of liquid biofertilizers on yield attributes of chickpea

It is apparent from data that different treatments significantly influenced on yield attributes of chickpea). Results revealed that the treatment 75% RDF + Liquid (Rhizobium+PSB+KSB) recorded the maximum No. of pods plant-1, No. of seeds pod-1, Test weight (g) 42.23, 1.69 and 178.10 at 40, 80 and at harvest, respectively which was at par with 100% Recommended Dose of Fertilizers (RDF) recorded No. of pods plant-1, No. of seeds pod-1, Test weight (g) 43.23, 1.70 and 183.87 at 40, 80 and at harvest, respectively which proved significantly superior to control but statistically found similar to all other treatments except treatment control.

Table 3.0: Effect of liquid biofertilizers on yield attributes of chickpea

Treatments	No of pods plant^{-1}	No. of seeds pod^{-1}	Test weight (g)
Control	25.62	1.28	104.27
100% Recommended Dose of Fertilizers (RDF)	43.23	1.70	183.87
Liquid Biofertilizer (Rhizobium+ PSB+KSB) alone	30.23	1.41	123.03
75% RDF	33.53	1.46	130.97
75% RDF+ Liquid Rhizobium	39.98	1.61	150.60

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75% RDF + Liquid PSB	36.86	1.54	143.07
75% RDF + Liquid KSB	34.13	1.50	137.63
75% RDF + Liquid (Rhizobium+PSB)	41.62	1.68	174.53
75% RDF + Liquid (Rhizobium+KSB)	40.56	1.65	171.13
75% RDF + Liquid (PSB+KSB)	40.44	1.62	157.87
75% RDF + Liquid (Rhizobium+PSB+KSB)	42.23	1.69	178.10
SEm±	1.22	0.03	7.34
CD (P=0.05)	3.61	0.08	21.65

EFFECT OF LIQUID BIOFERTILIZERS ON YIELD AND HARVEST INDEX OF CHICKPEA

It is apparent from data that different treatments significantly influenced on yield attributes of chickpea). Results revealed that the treatment 75% RDF + Liquid (Rhizobium+PSB+KSB) recorded the maximum seed yield Kg/ha stover yield kg/ha. and harvest index 1495, 4406 and 25.33, respectively which was at par with 100% Recommended Dose of Fertilizers (RDF) recorded the maximum seed yield kg/ha stover yield kg/ha and harvest index 1531, 4552 and 25.15, respectively which proved significantly superior to control but statistically found similar to all other treatments except treatment control.

Table 4.0: Effect of liquid biofertilizers on yield and harvest index of chickpea

Treatments	Seed yield ($kgha^{-1}$)	Stover yield ($kgha^{-1}$)	Biological yield ($kgha^{-1}$)	Harvest index
Control	588	1680	2768	21.28
100% Recommended Dose of Fertilizers (RDF)	1531	4552	6083	25.15
Liquid Biofertilizer (Rhizobium+ PSB+KSB) alone	793	2754	3547	22.20
75% RDF	980	3050	4030	24.42
75% RDF+ Liquid Rhizobium	1181	3438	4619	25.67
75% RDF + Liquid PSB	1126	3239	4366	25.81
75% RDF + Liquid KSB	1060	3117	4176	25.29
75% RDF + Liquid (Rhizobium+PSB)	1461	4376	5838	25.03
75% RDF + Liquid (Rhizobium+KSB)	1329	4189	5518	24.08
75% RDF + Liquid (PSB+KSB)	1256	3929	5185	24.52
75% RDF + Liquid (Rhizobium+PSB+KSB)	1495	4406	5902	25.33
SEm±	73	172	172	1.72
CD (P=0.05)	217	507	508	NS

NS= Non Significant

CONCLUSION

Yield attributes *viz.*, number of pods/plants, number of grains/pod and test weight was significantly improved due to use of liquid biofertilizers. Highest number of pods per plant (42.23) and test west (178.10 g) was found significantly more in 75% RDF + Liquid (Rhizobium+PSB+KSB) which closely followed by treatment 100% Recommended Dose of Fertilizers (RDF).

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This shows that the use of liquid biofertilizers application enhanced metabolic process of plant which resulted better yield attributes. Similar results were also obtained by Sharma and Abraham (2010) and Dubey *et al.*, (2013). Jat *et al*., (2015) found that foliar application of zinc sulphate and ferrous sulphate at branching and flower bud initiation stages increased the number of flower/plants, pods/plant, grains/pod and grain yield in green gram. This might be due to more number of new loading sinks and role of biofertilizers in metabolic activity. The higher photosynthetic rate, translocation and assimilation of metabolites in the sink which ultimately increase number of pods plants^{-1}. A similar result was reported by Singh *et al*. (2015).

NUTRIENT CONTENT AND UPTAKE

A perusal of data shows that the nutrient content and uptake of chickpea crop significantly influenced with the application of different treatments of biofertilizers investigation. Results indicated that the application of biofertilizers in combination as 75% RDF + Liquid (Rhizobium+PSB+KSB) improved the nutrients contents *viz.*, biofertilizers in chickpea grain and straw which closely followed by treatment 100% Recommended Dose of Fertilizers (RDF).

These results of showing increment in nutrient content and uptake are in line with those earlier reported by Singh *et al.* (2013). The current findings corroborate the findings of (Yadav *et al*. 2010 and Nandaniya *et al*. 2016). Pathak *et al*., (2012) revealed the amount of Zn in chickpea grains and leaves had increased after foliar fertilization of Zn deficient as well as Zn sufficient plants. The use of biofertilizers in a variety of pulses has boosted the concentration of nutrients in grains. The findings agree with those of Nandaniya *et al.* (2016) who discovered that Zn, B, and Mo significantly boosted chickpea and lentil straw yield.

Results further indicated that the application biofertilizers as 75% RDF + Liquid (Rhizobium+PSB+KSB) increased the protein content in chickpea grain. However, incorporating biofertilizers into grains may result in a large boost in protein production.

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