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*Research Article*

# Effect of Integrated Nutrient Management on Growth, Yield and Quality of Chickpea (*Cicer arietinum* L.)

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**ABSTRACT**

*A field experiment was conducted at in the Instructional Farm, Department of Agronomy, Faculty of Agriculture, AKS University, Sherganj, Satna (M.P.) to study the Effect of integrated nutrient management on growth, yield and quality of chickpea during rabi seasons of 2020- 21. Twelve treatments were evaluated in randomized block design with three replications. Results evident that use of 100 % RDF + Rhizobium + KSB significantly improved the plant height (38.35 cm) and number of branches per plant at 90 DAS (6.80), number of pods per plant (33.93), number of grains per pod (2.00) andseed index (18.65 g) of chickpea. Application of 100 % RDF + Rhizobium + KSB produced highest grain yield (18.83 q/ ha) and straw yield (23.98 q/ ha) of chickpea. The integrated use of chemical fertilizers and vermicompost improved the protein content in grain and maximum value (21.53 %) was recorded with 100 % RDF + Rhizobium + KSB. The results indicated that combined use of 100 % RDF + Rhizobium + KSB was the most appropriate nutrient management for higher growth, yield and quality parameters of chickpea.*

***Keywords:*** *Branches, Grain, Straw, Test weight, Protein content.*

## INTRODUCTION

Chickpea (*Cicer arietinum* L.) is an important pulse crop grown in tropical, subtropical and temperate regions of the world. It is world's third most important pulse crop after beans and peas with India accounting for approximately 65% of area and 64% of production of the world (F.A.O., 2008). India occupies 9.18 million ha area and 8.22 million tones production along with 900 kg/ha productivity of chickpea (Anonymous, 2017).

Pulse crops not only supply the protein but also enrich the soil fertility through symbiotic nitrogen fixation.

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Although chickpea fixes nitrogen from atmosphere, there is strong evidence that nitrogen fertilizer increases seed yield, those of seed protein and amino acids. However, its requirements for nitrogen fertilizers are lower than those of other crops to obtain higher yield and improved seed quality (Dhima et al., 2015).

Fertilizers are the most important inputs in crop production. An adequate supply of chemical fertilizers is closely associated with growth and development of plant (Dinesh et al., 2014). Inorganic sources of nutrients have played a prominent role in increasing food grain production of the country in the past and going to be crucial input in future as well. But continuous use of only chemical fertilizers impure soil health reduces crop inputs responses and is not able to sustain crop productivity. Balanced and adequate use of fertilizers helps to maintain good soil health which is essential for agriculture production and national economy. Under such conditions an integrated approach is suggested through complementary use of inorganic and organic to boost and sustain soil fertility and crop productivity. Although sole application of some organic sources of nutrients to crops was found beneficial, however, complementary use of organic and inorganic fertilizers for crop production seems more productive and sustainable.

The overall productivity of chickpea in India is comparatively low due to various biotic and abiotic stress, since most of soil is going to depleted against the nutrients because of continuous use of chemical fertilizer and not use of organic sources of nutrients. In intensive agriculture, soil often gets sickness due to application of NPK fertilizers alone leading to decreased yields. Inorganic fertilizer alone cannot sustain the soil productivity as well as the large-scale use of only chemical fertilizers as a source of nutrients has less efficient. In recent years bio fertilizers, viz., *Rhizobium*, PSB and KSB that are ecofriendly and low-cost inputs, have emerged as an important and integral component of integrated plant nutrient supply system for pulse crop production. Bio fertilizers, a type of organic fertilizers, are emerging as an ecologically safe means of fertilization. It is defined as a substance which contains living micro-organisms which, when applied to seed, plant surfaces, or soil, colonizes the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant. Therefore, an integrated approach to plant nutrient management gained momentum and importance in recent years. Hence, present investigation was carried out to study the growth, yield and qualitative behavior of chickpea to define optimum dose under integrated use of bio-organics and fertilizers.

## MATERIALS AND METHODS

The experiment was carried out at the Instructional Farm, Faculty of Agriculture, AKS University, Satna (M.P.) during rabi season 2020-21. The experiment was conducted in Randomized block design with three replications. The treatments were; T1= Control, T2=100 % RDF, T3=100 % RDF + *Rhizobium* , T4= 75 % RDF + *Rhizobium* , T5= 75% RDF + *Rhizobium* + PSB, T6= 75 % RDF + PSB, T7= 75 % RDF + *Rhizobium* + PSB + KSB, T8= 100 % RDF + KSB, T9= 75 % RDF + KSB, T10= 100 % RDF + PSB + KSB, T11= 100 % RDF + *Rhizobium* + KSB and T12= 75% RDF + PSB + KSB. The chickpea variety (JG-63) was sown on 25th October 2020 using 80 kg seeds per ha. The gross and net plot size was 5.0 m x 3.5 m and 4.0 m x 3.0 m, respectively. The N, P2O5 and K2O were applied through urea, single super phosphate and muriate of potash, respectively at the rate of 20 kg N/ha, 60 kg P2O5/ha and 25 Kg K2O /ha, respectively was uniformly applied to each plot (except control plots) as basal dose at

the time of sowing. In the experiment biofertilizers i. e. *Rhizobium* , PSB and KSB were used for this investigation. 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. The other crop management practices were followed as per standard recommendation. The crop was harvested at the physiological maturity. 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 (38.35 cm) and number of branches per plant at 90 DAS (6.80) at maximum crop growth stage of 90 DAS were observed under the integrated use of chemical fertilizers and bio- organics with 100 % RDF + *Rhizobium* + KSB while, lowest values were observed under the control.

Data regarding number of pods per plant, number of grains per pod, seed index, grain yield/ha, straw yield per hectare and protein content are reported in Table- 1 and maximum values were observed when crop fertilized with integration of chemical fertilizers and biofertilizers. Statistical analysis of the data revealed that highest number of pods per plant (33.93), number of grains per pod (2.00) and seed index (18.65 g),grain yield (18.83 q/ ha) and straw yield (23.98 q/ ha) per hectare and protein content (21.53 %) recorded under the integrated use of chemical fertilizers and biofertilizers with 100 % RDF + *Rhizobium* + KSB.

The combined treatment of 100 % RDF + *Rhizobium* + KSB showed significant improvement in plant height, production of branches and leaves per plant, dry weight of plant, length of root and no. of nodules per plant as compared to remaining practices. The basal application of chemical fertilizers meets the nutritional requirement of crop for proper establishment and growth during the initial period. At subsequent stages bio-organics ensures the proper supply of macro and micro nutrients, vitamins and plant growth promoting hormones which have positive effect on plant growth and development. Similar findings were also reported by Meena and Ram (2013) and Prajapati et al. (2017).

The use of recommended dose of fertilizers with *Rhizobium* and KSB would have facilitated better aeration, adequate drainage, improved soil biological activities and created a favorable soil environment for deeper proliferation of roots and higher nutrient extraction from soil, caused more vigorous plant growth. The increased plant height and branches might be due to the involvement of nutrients in cell wall development and cell differentiation which resulted in elongation of shoot and root in plants. The highest leaves and branches might be due to more roots and associated increased light interception and enhanced photosynthetic rate, which ultimately resulted in higher leaf and branches. Similar findings were also reported by Patil et al. (2014) and Ramesh et al. (2021).

The beneficial effect of inorganic and biofertilizers on root, leaf and branches might be due to synthesis of certain phytohormones, vitamins and more interception of solar radiation and synthesis of more chlorophyll which together all increased growth characters in chickpea. This may be due to fact that biofertilizers increases the adsorptive power of soil for cation and anion. These adsorbed ions are released slowly for entire crop growth period. *Rhizobium* is free living bacteria have specific role in fixing atmospheric nitrogen in soil which enhance the soil fertility with respect to nitrogen. Likewise, potassium solubilizing bacteria the fixed soil potassium and readily hydrolyzes the

organic potassium and degraded them in the soil through production of organic acids.

The maximum yield attributes of chickpea showed that the plants received 100 % RDF + *Rhizobium* + KSB registered significantly maximum number of pods per plant,number of seeds per pod, seed index,seed yield. This might be due to the fact that application of recommended dose of fertilizers with *Rhizobium* and KSB judiciously increased the nitrogen supply which resulted in the increased conversion of carbohydrates in to proteins which in turn are elaborated in to protoplasm. Similar findings were also reported by Ghetiya et al. (2018), Kumar et al. (2018) and Verma et al. (2020).

Increased values in these yield attributes might have been on account of the overall improvement in vegetative growth, which favorably influenced the flowering and fruiting and ultimately resulted into increased number of pods per plant, as well as number of grains per pod. These two parameters jointly increased grain yield per plant. Biofertilizer brought about significant improvement in different yield attributes. Increase in these parameters could be ascribed to the improvement in plant growth, vigor and production of sufficient photosynthesis during later part of growth period due to biofertilizer application. Similar findings were also reported by Verma et al. (2019) and Lokender et al. (2020). The higher seed yield achieved in the above promising INM treatment application was a combined effect of applied major nutrients, which increased availability of more nutrients through continuous slow release, which improved the growth parameters. Similar findings were also reported by Dinesh et al. (2014).

The protein content significantly increased with application of 100% recommended dose of fertilizer + Rhizobium + KSB. The higher protein content under this INM treatment might be due to the fact that nitrogen is an integral part of protein and phosphorus is structural element of certain co-enzymes involved in protein synthesis. The findings are akin to the report of Verma et al. (2017a) and Nandan et al. (2018).

**Table 1: Effect of integrated nutrient management on growth, yield and quality of chickpea**

| Treatment | Plant height (cm) | Number of branches/ plant | Number of pods per plant | Number of grains per pod | Seed index (cm) | Grain yield (q/ha) | Stover yield (q/ha) | Protein content (%) |
|---|---|---|---|---|---|---|---|---|
| $T_1$=control plot | 19.99 | 2.33 | 17.53 | 1.07 | 12.84 | 6.03 | 17.53 | 19.25 |
| $T_2$ =100% RDF | 34.81 | 4.93 | 29.07 | 1.53 | 17.03 | 17.67 | 23.81 | 20.80 |
| $T_3$ =100% RDF + Rhizobium | 37.04 | 5.27 | 30.87 | 1.80 | 17.80 | 18.36 | 23.93 | 21.36 |
| $T_4$ =75% RDF + Rhizobium | 32.88 | 4.13 | 27.60 | 1.33 | 16.33 | 13.42 | 23.26 | 20.10 |
| $T_5$ =75% RDF + Rhizobium+PSB | 33.36 | 4.20 | 27.73 | 1.40 | 16.44 | 13.64 | 23.65 | 20.34 |
| $T_6$ =75% RDF +PSB | 32.08 | 3.53 | 26.67 | 1.20 | 16.21 | 10.78 | 18.38 | 19.70 |
| $T_7$ =75% RDF + Rhizobium+PSB+KSB | 34.10 | 4.67 | 28.40 | 1.47 | 16.58 | 14.22 | 23.73 | 20.50 |
| $T_8$ =100%RDF+KSB | 36.03 | 5.13 | 29.53 | 1.67 | 17.26 | 17.92 | 23.87 | 20.98 |
| $T_9$ =75% RDF+KSB | 31.51 | 3.27 | 26.47 | 1.13 | 15.09 | 9.69 | 18.08 | 19.54 |
| $T_{10}$=100%RDF+PSB+KSB | 36.60 | 5.20 | 30.60 | 1.73 | 17.73 | 18.25 | 23.90 | 21.20 |
| $T_{11}$ =100%RDF + Rhizobium+KSB | 38.35 | 6.80 | 33.93 | 2.00 | 18.65 | 18.83 | 23.98 | 21.53 |
| $T_{12}$ =75%RDF+PSB+ KSB | 32.25 | 3.73 | 26.80 | 1.27 | 16.24 | 12.86 | 22.45 | 19.75 |
| S. Em± | 0.73 ↓ | 0.26 ↓ | 0.64 ↓ | 0.14 ↓ | 0.38 ↓ | 0.96 ↓ | 0.43 ↓ | 0.21 ↓ |
| C.D. (P=0.05) | 2.14 | 0.75 | 1.86 | 0.41 | 1.12 | 2.79 | 1.24 | 0.62 |

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