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Maniram JakharVivekananda Global University,
Jaipur, Rajasthan, India**PK Sharma**Vivekananda Global University,
Jaipur, Rajasthan, India**Rameshr Lal Mandeewal**Central Sheep and Wool
Research Institute, Avikanagar,
Tonk, Rajasthan, India**Ramesh Choudhary**College of Agriculture, SKRAU,
Bikaner, Rajasthan, India

Effect of integrated nutrient management on growth attributes, nitrogen content, nitrogen uptake and quality of chickpea (*Cicer arietinum* L.)

Maniram Jakhar, PK Sharma, Rameshr Lal Mandeewal and Ramesh Choudhary

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Abstract

A field experiment was undertaken during *Rabi* season of 2018-19 at Research Farm, Vivekananda Global University, Jaipur to study the effect of integrated nutrient management on growth and quality of chickpea. The experiment was taken in randomized block design with three replication assigning seven treatment combinations of inorganic fertilizers, FYM, vermicompost and bio-fertilizers. Results showed that the growth and quality of chickpea was significantly increased due to different integrated nutrient management treatments as compared to control. The maximum plant height, number of branches plant⁻¹, nitrogen content in seed and haulm, nitrogen uptake in seed and haulm, protein content in seed and protein yield of chickpea was obtained with combined application of 75% RDF + vermicompost 2.5 t ha⁻¹ + *PSB* (T₇) which was superior to all other treatments except application of 100% RDF (T₂) and 75% RDF + FYM 5.0 t ha⁻¹ *PSB* (T₆).

Keywords: Chickpea, RDF, FYM, vermicompost, *PSB*, nitrogen & protein content

Introduction

Chickpea (*Cicer arietinum* L.) is an important pulse crop grown in all the regions of the world. It is world's third most important pulse crop after beans and peas. India is the largest producer of chickpea contributing highest share in area (65.3%) and production (67.2%) in the world (FAO, 2017)^[4]. The chickpea is generally grown on rain fed marginal and sub marginal lands which are low in fertility and faces various biotic and abiotic stresses. Therefore, the overall productivity of chickpea in India is comparatively low as compared to other countries. Large scale use of only chemical fertilizers as a source of nutrients has less efficient and thus inorganic chemical fertilizers alone cannot sustain the soil productivity (Kumar *et al.*, 2003)^[7]. In recent year's bio fertilizers *viz.* *Rhizobium* and *PSB* along with organic manures 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. Hence, to combat this problem and to sustain production of chickpea, the present investigation was carried out to find out appropriate nutrient management module with the integration of inorganic fertilizers, FYM, vermicompost and bio-fertilizers in chickpea.

Materials and Methods

A field experiment was conducted during the *Rabi* season 2018-19 at Research Farm, Vivekananda Global University, Jaipur. This region falls under agro-climatic zone III A of Rajasthan (Semi-arid Eastern Plain Zone). The experiment was laid out in randomized block design with three replications, assigning seven treatment combinations *viz.*, control (T₁), 100% RDF (T₂), 75% RDF (T₃), 75% RDF + FYM 5 t ha⁻¹ (T₄), 75% RDF + vermicompost 2.5 t ha⁻¹ (T₅), 75% RDF + FYM 5 t ha⁻¹ + *PSB* (T₆) and 75% RDF + vermicompost 2.5 t ha⁻¹ + *PSB* (T₇). The total rainfall received during the crop season was 16.6 mm. The soil of experiment site was loamy sand in texture having 0.19% organic carbon, 142.3 kg ha⁻¹ available nitrogen, 19.4 kg ha⁻¹ available P₂O₅ and 224.2 kg ha⁻¹ available potassium. The recommended dose of fertilizer *i.e.* 20 kg N and 40 kg P₂O₅ ha⁻¹ was applied at sowing as basal dose through urea and DAP. Organic manures *i.e.* vermi-compost and FYM containing 1.67% N, 1.20% P₂O₅ and

Corresponding Author:**Maniram Jakhar**Vivekananda Global University,
Jaipur, Rajasthan, India

0.89% K₂O and 0.5% N, 0.25% P₂O₅ and 0.5% K₂O, respectively were thoroughly mixed in soil before sowing. The seeds of chickpea variety RSG-888 were sown manually using a seed rate of 80 kg ha⁻¹ at 30 cm row spacing. Two post sowing irrigations were applied through sprinkler. Nitrogen content in seed and straw was estimated by colorimeter method using Nessler's reagent (Snell and Snell, 1949)^[10] and expressed in percentage. Nitrogen uptake (kg ha⁻¹) was calculated by multiplying nitrogen content in seed and haulm with respective yields and divided by 100. Protein content in grain was calculated by multiplying percent nitrogen content in seed by 6.25 (AOAC, 1960)^[11]. Protein yield (kg ha⁻¹) was calculated by multiplying protein content in grain with seed yields and divided by 100. The data related to growth and quality of chickpea were recorded and statistically analyzed as per guidelines of Fischer (1950).

Result and Discussion

The experimental findings presented in Table 1 revealed that different integrated nutrient management treatments bring significant effect on plant height at 60, 90 DAS and at harvest and number of branches plant⁻¹ at harvest of chickpea. The maximum plant height at 60 DAS (46.68 cm), 90 DAS (64.46 cm), at harvest (64.53 cm) and number of branches plant⁻¹ (10.01) at harvest was recorded with the application of 75% RDF + vermicompost 2.5 t ha⁻¹ + PSB (T₇) which was found at par with T₆ and T₂ and statistically superior over rest of the treatments. The reason for better growth and development in the above treatments might be due to the greater availability of nutrients in soil due to increasing fertilizer application with vermicompost and biofertilizer might have enhanced meristematic activity leading increased availability of major nutrients to plant from deeper layers of soil ultimately resulting in increased plant growth in terms of plant height, number of branches and dry matter accumulation. These results are in close conformity with the findings of Ahmed *et al.* (2017)^[2], Singh *et al.* (2017)^[8] and Kumar *et al.* (2018)^[6] in chickpea.

Further data revealed in Table 2 that the various treatments of integrated nutrient management increased the nitrogen content in seed and haulm significantly over control. The significantly higher nitrogen content in seed (3.86%) and haulm (0.88%) of chickpea was obtained by the application of 75% RDF + vermicompost at 2.5 t ha⁻¹ + PSB which was found significantly superior over control, 75% RDF, 75% RDF +

FYM 5.0 t ha⁻¹ and 75% RDF + vermin-compost 2.5 t ha⁻¹ but on at par with 100% RDF and 75% RDF + FYM 5.0 t ha⁻¹ + PSB. This might be due to adequate availability of the nutrients in the root zone and increased availability of phosphorus to the chickpea crop by the application of organic manure and biofertilizer. Increased content of nutrient in plant ascribed to the beneficial role of nutrients in soil through added fertilizers in addition to inherent nutrient content present in the soil which enhanced the available nutrient pool of the soil. The favorable conditions for microbial as well as chemical activities due to addition of fertilizers application in combination with vermicompost and biofertilizers increased the mineralization of nutrients and ultimately the available nutrient pool of the soil led to higher content of nutrients in seed and straw. The increase in nutrient content in seed and straw with seed inoculation with PSB might be due to increased availability of phosphorus to the plants, which might have utilized by the crop in greater root development and nodulation resulted in higher nitrogen fixation in the soil by root nodules. The findings of this investigation are in line with Tolanur (2008)^[12], Sohu *et al.*, (2015)^[11] and Dewangan *et al.* (2016)^[3] in chickpea crop.

The experimental findings revealed that different treatments of integrated nutrient management had significant difference on nitrogen uptake by seed and haulm of chickpea. Significantly higher nitrogen uptake by seed (71.46 kg ha⁻¹) and haulm (29.09 kg ha⁻¹) of chickpea was recorded by the application of 75% RDF + vermicompost at 2.5 t ha⁻¹ + PSB as compared to control, 100% RDF, 75% RDF, 75% RDF + FYM 5.0 t ha⁻¹ and 75% RDF + vermicompost 2.5 t ha⁻¹ but closely followed by 75% RDF + FYM 5.0 t ha⁻¹ + PSB. The higher nitrogen content with increased seed and haulm yields probably led to the more uptake of nitrogen by the chickpea crop. Significant increase in nitrogen content and uptake under the present study are in close agreement with the findings of Singh *et al.* (2017a)^[9] and Kumar *et al.* (2018)^[6] in chickpea crop.

The application of 75 % RDF + Vermicompost 2.5 t ha⁻¹ + PSB also improved the protein content (24.15%) and protein yield (447.98 kg ha⁻¹) of chickpea which was significantly superior over all the treatments except 100% RDF and 75% RDF + FYM 5 t ha⁻¹ + PSB. This might be due to higher nitrogen content in seed which was obtained with combined application of chemical fertilizers and organic manure along with biofertilizer seed inoculation.

Table 1: Effect of integrated nutrient management on growth attributes of chickpea

| Treatments | Plant height (cm) | | | | Number of branches at harvest |
|---|-------------------|--------|--------|---------|-------------------------------|
| | 30 DAS | 60 DAS | 90 DAS | Harvest | |
| Control | 11.24 | 29.58 | 40.48 | 40.60 | 6.05 |
| 100% RDF | 11.78 | 45.64 | 62.89 | 62.93 | 9.75 |
| 75% RDF | 11.36 | 37.19 | 50.52 | 50.64 | 7.80 |
| 75% RDF + FYM 5 t ha ⁻¹ | 11.50 | 37.96 | 51.65 | 51.70 | 7.91 |
| 75% RDF + VC 2.5 t ha ⁻¹ | 11.62 | 38.56 | 52.30 | 52.36 | 8.03 |
| 75 % RDF + FYM 5 t ha ⁻¹ + PSB | 11.89 | 46.29 | 63.40 | 63.45 | 9.89 |
| 75% RDF + VC 2.5 t ha ⁻¹ + PSB | 11.97 | 46.68 | 64.46 | 64.53 | 10.01 |
| SEm± | 0.61 | 2.09 | 2.86 | 2.86 | 0.46 |
| Cd (P = 0.05) | NS | 6.46 | 8.82 | 8.82 | 1.42 |
| CV (%) | 9.02 | 9.01 | 9.00 | 8.99 | 9.41 |

Table 2: Effect of integrated nutrient management on nitrogen content, nitrogen uptake, protein content and protein yield of chickpea

| Treatments | N Content (%) | | N uptake (kg ha ⁻¹) | | Protein content in seed (%) | Protein yield (kg ha ⁻¹) |
|---|---------------|-------|---------------------------------|-------|-----------------------------|--------------------------------------|
| | Seed | Haulm | Seed | Haulm | | |
| Control | 3.15 | 0.55 | 34.46 | 10.64 | 19.69 | 215.39 |
| 100% RDF | 3.79 | 0.84 | 60.67 | 24.29 | 23.71 | 379.19 |
| 75% RDF | 3.43 | 0.71 | 45.70 | 16.81 | 21.42 | 285.61 |
| 75% RDF + FYM 5 t ha ⁻¹ | 3.47 | 0.73 | 54.07 | 20.35 | 21.67 | 337.95 |
| 75% RDF + VC 2.5 t ha ⁻¹ | 3.49 | 0.74 | 55.39 | 20.87 | 21.79 | 346.21 |
| 75% RDF + FYM 5 t ha ⁻¹ + PSB | 3.83 | 0.86 | 70.73 | 28.15 | 23.96 | 442.08 |
| 75% RDF + VC 2.5 t ha ⁻¹ + PSB | 3.89 | 0.88 | 71.46 | 29.09 | 24.15 | 446.61 |
| SEm± | 0.08 | 0.02 | 2.25 | 1.12 | 0.51 | 15.84 |
| Cd (P = 0.05) | 0.25 | 0.07 | 7.81 | 3.46 | 1.56 | 48.80 |
| CV (%) | 3.92 | 4.90 | 7.83 | 9.07 | 3.92 | 7.83 |

Conclusion

On the basis of experimental results, it may be concluded that application of 75% RDF (20 kg N + 30 kg P₂O₅ ha⁻¹) along with 2.5 t ha⁻¹ vermicompost and inoculation of seed with PSB was found superior to produce better growth and quality of chickpea as it gave higher plant height, number of branches, nitrogen content, nitrogen uptake, protein content and total protein yield.

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