Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

**E-ISSN:** 2278-4136
**P-ISSN:** 2349-8234
www.phytojournal.com
JPP 2020; 9(6): 623-626
Received: 16-08-2020
Accepted: 09-10-2020

**HA Patel**
Ph.D., Student, Department of Agronomy, N.M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

**JD Thanki**
Professor and Head, Department of Agronomy, N.M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

**Corresponding Author:**
**HA Patel**
Ph.D., Student, Department of Agronomy, N.M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

# Effect of integrated nutrient management on growth, yield, soil nutrient status and economics of chickpea (*Cicer arietinum* L.) under south Gujarat conditions

**HA Patel and JD Thanki**

**Abstract**
A field experiment was conducted at the College Farm, Navsari Agricultural University, Navsari (Gujarat) during *rabi* seasons of 2017-18 and 2018-19. There were five treatments imposed in chickpea *viz*., $T_1$ - 100% RDF, $T_2$ - 75% RDF, $T_3$ - 100% RDF + *Rhizobium* + PSB, $T_4$ - 75% RDF + *Rhizobium* + PSB, $T_5$ - control. General application of FYM in 2.5 t/ha. These treatments were evaluated replicated four times in randomized block design. Application of 100% RDF + *Rhizobium* + PSB ($T_3$) recorded significantly higher almost all the growth attributes *viz*., plant height, number of branches per plant, dry matter accumulation per plant, volume of nodules per plant, yield attributes and yield *viz*., number of pods per plant, seed index, seed yield per plant, seed yield, stover yield as well as available nutrient status in soil but remained at par with 100% RDF ($T_1$) and 75% RDF + *Rhizobium* + PSB ($T_4$). Likewise, economics was remarkably improved due to inorganic fertilizers as well as combination of inorganic fertilizers with biofertilizers (*Rhizobium* + PSB).

**Keywords:** Chickpea, integrated nutrient management, yields

## Introduction
Pulses as a candidate crop, contributes immensely towards doubling farmers' income through diminishing cost of production, scaling per unit productivity, efficient marketing networks and successful technology delivery mechanisms by giving emphasis sustainable intensification and crop diversification, climate resilient production technologies backed with strong research outputs in pulses can contribute towards doubling the farmers' income (Singh, 2018) [11]. In India, pulses are grown in an area of 29.99 million hectares with total production of 25.23 million tonnes with productivity of 841 kg/ha. While in Gujarat, it is grown over an area of 0.91 million hectares with an annual production of 0.93 million tonnes with the productivity of 1022 kg/ha (Anonymous, 2018) [2].

Chickpea (*Cicer arietinum* L.) is an important pulse crop grown and consumed all over the world. It is a good source of vitamins such as riboflavin, niacin, thiamin, folate, A precursor, β-carotene and the protein quality is considered to be better than other pulses. chickpea is rich in nutritionally important unsaturated fatty acids like linoleic and oleic acid. It could have beneficial effects on some of the important human diseases like cardiovascular disease, type 2 diabetes, digestive diseases and some cancers. In India, chickpea are grown in an area of 10.56 million hectares with total production of 11.23 million tonnes with productivity of 1063 kg/ha. While in Gujarat, chickpea is grown in an area of 0.29 million hectares producing 0.37 million tonnes with the productivity of 1253 kg/ha (Anonymous, 2018) [3].

The basic concept of integrated nutrient management (INM) is the maintenance of soil fertility and supply plant nutrients to an optimum level for sustaining the desired crop productivity through optimization of benefits from all possible sources of plant nutrients in an integrated manner. Nitrogen, phosphorus and biofertilizers like *rhizobium* and *phosphate solubilizing bacteria* play a vital role in the nutrition of plants. In fact, these fertilizer nutrients are lacking mostly in the soils. Fertility analysis of Indian soils has indicated that the soils are deficient in micro-organisms and nutrients. Therefore, application of biofertilizers and inorganic fertilizers becomes essential to raise the crop yield. *Rhizobium* has an enormous potential to fix atmospheric nitrogen. *Phosphate solubilizing bacteria* (PSB) solubilize the unavailable bound phosphates of the soil and make them available to plants which increase overall plant growth resulting in 10 to 15% increase in yield.

## Material and Methods

The present study entitled "Effect of integrated nutrient management on growth, yield, soil nutrient status and economics of chickpea (*Cicer arietinum* L.) under south Gujarat conditions" will be carried out during the *rabi* seasons of 2017-18 and 2018-19. The soil of experimental field was clay in texture and low in organic carbon (0.42%) and available nitrogen (196.80 kg/ha), medium in available phosphorus (38.30 kg/ha), high in available potassium (315.43 kg/ha) and slightly alkaline in reaction (pH 8.23). The treatments consisted of integrated nutrient management *viz*., $T_1$ - 100% RDF, $T_2$ - 75% RDF, $T_3$ - 100% RDF + *Rhizobium* + PSB, $T_4$ - 75% RDF + *Rhizobium* + PSB, $T_5$ - control. General application of FYM in 2.5 t/ha to chickpea in *rabi* season and replicated four times in randomized block design. Recommended dose of fertilizer (RDF) for *rabi* chickpea is 20 N + 40 $P_2O_5$ + 00 $K_2O$ kg/ha.

Chickpea cv. GG 2 was sown with spacing of 30 X 10 cm in November and harvested in March during both the years. The chickpea crop was fertilized as per treatment. The nitrogen was applied through urea (46% N) whereas phosphorus was applied through single superphosphate (16% $P_2O_5$). The recommended dose of fertilizer was applied at the time of sowing. Inoculation of biofertilizers (*Rhizobium* + PSB each of 10 ml/kg) to chickpea seeds according to treatment of plot in both the years before sowing. The inoculated seeds were dried under shade and were sown as per the treatments. General application of farm yard manure was applied to chickpea crop as evenly spread and mixed in that particular bed.

## Results and Discussion

Data presented in (Table 1) indicated that the plant height was significantly influenced by different treatments tried in the experiment at all the stages of crop growth except at 30 DAS in pooled analysis. On the basis of pooled analysis plant height, number of branches per plant and dry matter accumulation per plant and volume of nodules per plant were significantly influenced due to effect of different treatments. Significantly higher plant height at 60 DAS and at harvest was recorded under treatment 100% RDF+ *Rhizobium* + PSB ($T_3$) being remained at par with treatment 100% RDF ($T_1$) and 75% RDF + *Rhizobium* + PSB ($T_4$). Application of 100% RDF + *Rhizobium* + PSB ($T_3$) resulted in significantly higher number of branches per plant, dry matter accumulation per plant at 30 DAS, 60 DAS and at harvest during pooled analysis at par with treatment 100% RDF ($T_1$) and 75% RDF + *Rhizobium* + PSB ($T_4$).

**Table 1:** Plant height, number of branches per plant, dry matter accumulation per plant and volume of nodules per plant of chickpea as influenced periodically by different treatments (Pooled results)

| Treatment | Plant height (cm) | | | Number of branches/plant | | | Dry matter accumulation/plant (g) | | | Volume of nodules/plant(ml) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30 DAS | 60 DAS | At harvest | 30 DAS | 60 DAS | At harvest | 30 DAS | 60 DAS | At harvest | 30 DAS | 50 DAS |
| $T_1$ | 15.79 | 33.18 | 48.12 | 4.94 | 8.41 | 10.95 | 2.72 | 10.82 | 22.98 | 1.31 | 2.40 |
| $T_2$ | 15.21 | 31.15 | 44.06 | 4.31 | 7.55 | 10.18 | 2.27 | 9.74 | 19.73 | 1.00 | 1.72 |
| $T_3$ | 15.97 | 34.47 | 50.96 | 5.02 | 8.59 | 11.17 | 2.81 | 11.35 | 23.54 | 1.44 | 2.68 |
| $T_4$ | 15.52 | 32.35 | 47.52 | 4.56 | 8.08 | 10.55 | 2.53 | 10.65 | 22.07 | 1.08 | 1.82 |
| $T_5$ | 14.82 | 26.32 | 41.56 | 3.73 | 6.65 | 9.52 | 1.93 | 8.67 | 17.42 | 0.84 | 1.16 |
| S.Em+ | 0.32 | 0.73 | 1.18 | 0.10 | 0.18 | 0.22 | 0.05 | 0.24 | 0.50 | 0.02 | 0.05 |
| CD (P=0.05) | NS | 2.14 | 3.46 | 0.30 | 0.52 | 0.64 | 0.15 | 0.71 | 1.48 | 0.07 | 0.13 |
| CV (%) | 5.83 | 6.52 | 7.16 | 6.42 | 6.31 | 5.84 | 5.90 | 6.62 | 6.73 | 5.86 | 6.57 |
| General mean | 15.46 | 31.49 | 46.45 | 4.51 | 7.86 | 10.47 | 2.45 | 10.24 | 21.15 | 1.13 | 1.96 |
| **Interaction (Y x T)** | | | | | | | | | | | |
| S.Em+ | 0.45 | 1.03 | 1.66 | 0.15 | 0.25 | 0.31 | 0.07 | 0.34 | 0.71 | 0.03 | 0.06 |
| CD (P=0.05) | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |

**Table 2:** Number of pods per plant, seed index, seed yield per plant, seed yield, stover yield and harvest index of chickpea as affected by different treatments (Pooled results)

| Treatment | Number of pods/plant | Seed index (g) | Seed yield/plant (g) | Seed yield (q/ha) | Stover yield (q/ha) | Harvest index (%) |
|---|---|---|---|---|---|---|
| $T_1$ | 36.97 | 23.27 | 8.34 | 22.20 | 41.67 | 34.72 |
| $T_2$ | 34.54 | 22.02 | 7.64 | 19.73 | 39.88 | 33.09 |
| $T_3$ | 38.92 | 24.52 | 8.62 | 23.47 | 42.76 | 35.40 |
| $T_4$ | 36.94 | 23.04 | 7.99 | 21.75 | 41.40 | 34.45 |
| $T_5$ | 33.71 | 20.60 | 7.02 | 17.77 | 36.74 | 32.24 |
| S.Em+ | 0.68 | 0.52 | 0.22 | 0.79 | 0.46 | 1.01 |
| CD (P=0.05) | 1.99 | 1.52 | 0.66 | 2.33 | 1.36 | NS |
| CV (%) | 5.29 | 6.44 | 7.95 | 10.66 | 3.24 | 8.41 |
| General mean | 36.22 | 22.69 | 7.92 | 20.99 | 40.49 | 33.98 |
| **Interaction (Y x T)** | | | | | | |
| S.Em+ | 0.96 | 0.73 | 0.32 | 1.12 | 0.66 | 1.43 |
| CD (P=0.05) | NS | NS | NS | NS | NS | NS |

**Table 3:** Available nutrient (N, $P_2O_5$ and $K_2O$) status of soil as influenced by different treatment after harvest of chickpea (Pooled results)

| Treatment | Available N (kg/ha) | Available $P_2O_5$ (kg/ha) | Available $K_2O$ (kg/ha) |
|---|---|---|---|
| $T_1$ | 228.20 | 45.67 | 322.60 |
| $T_2$ | 214.39 | 41.47 | 303.78 |
| $T_3$ | 233.59 | 46.81 | 328.83 |
| $T_4$ | 225.80 | 44.40 | 305.83 |
| $T_5$ | 197.80 | 40.63 | 293.82 |
| S.Em+ | 2.67 | 0.83 | 8.56 |

| | | | |
|---|---|---|---|
| CD (P=0.05) | 7.84 | 2.43 | NS |
| CV (%) | 3.43 | 5.34 | 7.79 |
| General mean | 219.96 | 43.80 | 310.97 |
| **Interaction (Y x T)** | | | |
| S.Em+ | 3.77 | 1.17 | 12.11 |
| CD (P=0.05) | NS | NS | NS |

**Table 4:** Economics of chickpea as influenced by different treatments (Average 2017-18 and 2018-19)

| Treatment | Yield (q/ha) | | Cost (Rs./ha) | | Cost of cultivation | Gross monetary returns | Net monetary returns | B:C ratio |
|---|---|---|---|---|---|---|---|---|
| | Seed | Stover | Fixed | Variable | | | | |
| $T_1$ | 22.20 | 41.67 | 32435 | 7094 | 39529 | 147785 | 108256 | 2.74 |
| $T_2$ | 19.73 | 39.88 | 32435 | 6570 | 39005 | 132338 | 93333 | 2.39 |
| $T_3$ | 23.47 | 42.76 | 32435 | 7334 | 39769 | 155786 | 116017 | 2.92 |
| $T_4$ | 21.75 | 41.40 | 32435 | 6810 | 39245 | 144990 | 105745 | 2.69 |
| $T_5$ | 17.77 | 36.74 | 32435 | 5000 | 37435 | 119479 | 82044 | 2.19 |

The plant height in chickpea tended to increase due to quick release of available nitrogen synthesized by root rhizobia to the plant at the time of vegetative growth. The increase in number of branches per plant to increasing fertilizer level and biofertilizers might be due to improvement in nutrient availability that enhanced horizontal expansion of chickpea by encouraging cell division in the meristematic region. Nitrogen and phosphorus might have increased the photosynthetic efficiency and thus increased the production of photosynthates. This is in agreement with the findings reported earlier by Jat *et al*. (2012), Tripathi *et al*. (2013), Singh *et al*. (2012) and Singh *et al*. (2017) [6, 13, 10, 12]. Moreover, application of 100% RDF + *Rhizobium* + PSB ($T_3$) produced significantly highest volume of nodules per plant at 30 and 50 DAS during pooled result. It was properly due to positive effect of biofertilizers and FYM by increasing the nodulation resulted higher fixation of atmospheric nitrogen and ultimately increased the growth characters.

The results presented in (Table 2) indicated to yield attributes *viz*., number of pods per plant, seed index (100 seed weight) and seed yield per plant, seed and stover yields were significantly influenced due to application of different treatments. Significantly higher number of pods per plant, seed index, seed yield per plant, seed and stover yields was recorded under the treatment of 100% RDF + *Rhizobium* + PSB ($T_3$) being at par with treatment 100% RDF ($T_1$) and 75% RDF + *Rhizobium* + PSB ($T_4$). While harvest index of chickpea due to different treatments did not exert any significant effect during pooled analysis. It may also be due to adequate availability of major nutrients which are required in larger quantity thus directly help the plants to register higher yield. An increase in the seed yield with general application of FYM served as reserves of macro and micro nutrients which are released during process of mineralization. These results are in close conformity with Kumar and Kumar (2008) Ali *et al*. (2010) Poonia and Pithia (2014) [7, 1, 9] as well as Singh *et al*. (2017) [12].

The soil available nitrogen, $P_2O_5$ and $K_2O$ kg/ha (Table 3) recorded after harvest of chickpea was significantly higher due to application of 100% RDF + *Rhizobium* + PSB ($T_3$) but it was found at par with 100% RDF ($T_1$) and 75% RDF + *Rhizobium* + PSB ($T_4$) during pooled result. This could be attributed to the fact that addition of inorganic fertilizers with biofertilizers and FYM to chickpea crop residues such as roots, stubbles, leaves, nodules and bodies of *Rhizobia* rich in nitrogen and greater N fixation. *Phosphate solubilizing bacteria* (PSB) solubilize the unavailable bound phosphates of the soil and make them available to plants. The present results are on the lines of the findings of Meena and Ram (2013), Gorade *et al*. (2014) and Dewangan *et al*. (2017) [8, 5, 4]. Maximum net monetary returns of and B:C ratio (Table 4) was recorded with application of 100% RDF + *Rhizobium* + PSB ($T_3$) followed by treatments 100% RDF ($T_1$) and 75% RDF + *Rhizobium* + PSB ($T_4$). The increase in gross income, Net income and B:C ratio may be due to higher production because more availability of nutrient with combine application of nutrient sources. Similar results were also reported by Kumar *et al*. (2017), Kumar *et al*. (2015), Singh *et al*. (2017) and Kumar *et al*. (2018) [12].

## Conclusion

Based on the results of pooled analysis, conclusion can be made that for getting higher grain yield, returns and maintenance of soil status, chickpea crop should be nourished with 75% RDF (15 N + 30 $P_2O_5$ + 00 $K_2O$ kg/ha) + *Rhizobium* (10 ml/kg seed) + PSB (10 ml/kg seed) with 2.5 t/ha FYM under south Gujarat condition.

## References


1. Ali A, Ali Z, Javaid I, Mustaq A, Naveed A, Akram HM *et al*. Impact of nitrogen and phosphorus on seed yield of chickpea. Journal Agricultural Research 2010;48(3):335-338.
2. Anonymous. Agricultural statistics at a glance. Ministry of Agriculture & Farmers' Welfare. Directorate of Economics & Statistics, DAC&FW 2018.
3. Anonymous. Report of the Committee for Doubling Farmers' Income, Department of Agriculture, Cooperation and Farmers' Welfare, Ministry of Agriculture & Farmers' Welfare 2018.
4. Dewangan S, Singh RJ, Singh S, Singh MK. Effect of integrated nutrients management and drought mitigating strategies on yield, water use efficiency and soil fertility of rainfed chickpea (*Cicer arietinum* L.). Indian Journal of Agriculture Science 2017;87(2):245-250.
5. Gorade VN, Chavan LS, Jagtap DN, Kolekar AB. Response of green gram (*Vigna radiata* L.) varieties to integrated nutrient management in summer season. Agricultural Science Digest 2014;34(1):36-40.
6. Jat SL, Prasad K, Parihar CM. Effect of organic manuring on productivity and economics of summer mungbean. Annals of Agriculture Research (New Series) 2012;33(1&2):17-20.
7. Kumar R, Kumar S. Effect of management practices on the growth and yield of rainfed chickpea. National Journal of Plant Improvement 2008;10(1):49-52.

8. Meena BS, Ram B. Effect of integrated nutrient management on productivity, soil fertility and economics of chickpea (*Cicer arietinum* L.) varieties in vertisols. Ann. Agric. Res. New Series 2013;34(3):225-230.
9. Poonia TC, Pithia MS. Increasing efficiency of seed inoculation with biofertilizers through application of micronutrients in irrigated chickpea. African Journal of Agricultural Research 2014;9(29):2214-2221.
10. Singh G, Sekhon HS, Harpreet Kaur. Effect of farmyard manure, vermicompost and chemical nutrients on growth and yield of chickpea (*Cicer arietinum* L). International Journal of Agricultural Research 2012;7(2):93-99.
11. Singh NP. Indian Farming 2018;68(01):36-43.
12. Singh R, Kumar S, Kumar H, Kumar M, Kumar A, Kumar D. Effect of irrigation and integrated nutrient management on growth and yield of chickpea (*Cicer arietinum* L.). Plant Archives 2017;17(2):1319-1323.
13. Tripathi LK, Thomas T, Kumar S. Impact of nitrogen and phosphorus on growth and yield of chickpea (*Cicer arietinum* L.). An Asian Journal Soil Science 2013;8(2):260-263.