

IMPACT OF FERTILIZATION ON UPTAKE OF NUTRIENTS, NUTRITIONAL QUALITY AND YIELD OF CHICKPEA GROWN ON FARMERS FIELDS IN CHANDUR BAZAR TALUKA OF AMRAVATI DISTRICT

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ABSTRACT

The present investigation entitled “Impact of fertilization on uptake of nutrients and yield of chickpea in Chandur Bazar taluka of Amravati district” was carried out during *rabi* season of 2020-2021. The chickpea growing farmer’s field of various locations *viz.*, Jawala, Kondwardha, Jainpur, Thugaon, Pimpri, Kurha, Shirala, Fubgaon and Madhan of Chandur Bazar tahsil were selected for recording various observations and considering the application of different nutrient management practices with irrigations and on residual moisture with objective to assess the effect of fertilizers on nutrient uptake and yield of chickpea. Each 20 plants and grain samples were collected from nine locations after harvest of chickpea from Chandur Bazar taluka of Amravati district. The total uptake of N, P, K of chickpea varied from 47.73-106.72 kg ha⁻¹, 9.37-22.46 kg ha⁻¹ and 27.74-64.67 kg ha⁻¹, respectively. The concentration of nutritional quality parameters like protein, methionine cysteine, calcium and sulphur of chickpea grains varied from 18.63-21.90%, 1.37-1.82 g 100 g⁻¹N, 1.29-1.43 g 100 g⁻¹N, 0.24-0.36% and 0.26-0.53%, respectively were influenced by the application of various types of chemical fertilizers and INM. The highest yield of chickpea was observed with the application of 34 kg N, 67.5 kg P₂O₅ and FYM@ 10 t ha⁻¹, 32.35 and 30.37 per cent grain yield was increased with integrated nutrient management practices under residual moisture and irrigations over the application of chemical fertilizers + residual moisture and chemical fertilizer + irrigations.

(Key words: Chickpea, fertilizer doses, INM, nutrient uptake, nutritional quality, yield)

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is the foremost pulse crop in India. Seed is the main edible part of the plant and rich source of protein (21.1%), carbohydrate (56.5%), fat (2-4%), calcium and iron (10-12%). India accounts 70.9% of global chickpea production (10.13 metric tonnes). In India Madhya Pradesh, Maharashtra and Rajasthan contributes 70 per cent of total production. Chickpea fixes atmospheric nitrogen and economizes nitrogen application for succeeding cereal crop to the tune of 56-68 kg N ha⁻¹. Fertilizers are the most important inputs in crop production. Most of the farmers generally supplied imbalance fertilizer and not applied recommended dose on soil test report and also does not applied organic material to the soil which reflected on uptake of nutrients and ultimately effect on nutritional quality of produce, therefore, it is felt necessary to study the influence of different fertilizer management practices on nutritional quality, uptake of nutrients and yield of chickpea.

MATERIALS AND METHODS

The present investigation was undertaken to study the impact of fertilization on uptake of nutrients, nutritional quality and yield of chickpea in Chandur Bazar taluka of Amravati district. Total 40 samples were collected 20 plants and grain samples from farmer’s field on the basis of different fertilization practices such as chemical fertilizers + residual moisture, INM + residual moisture, chemical fertilizers+irrigations and INM + irrigations. The plant samples were further used for studying total nitrogen, phosphorus and potassium percentage in plant after harvest of chickpea and grain samples used for estimation of protein content, S- containing amino acids, sulphur and calcium. The available soil N, P, K and S in soil varied from 13.60-251.0 kg ha⁻¹, 7.71-24.93 kg ha⁻¹, 287.14-621.80 kg ha⁻¹ and 9.21-19.36 mg kg⁻¹, respectively with application of different fertilization practices.

The samples were processed and analyzed in the laboratories of Soil Science and Agricultural Chemistry section, College of Agriculture, Nagpur during 2020-2021.

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In plant and grain analysis total nitrogen was estimated by Kjeldahl's method described by Piper (1966). Total phosphorus was determined by Vanadomolybdate method (Jackson, 1973) and total potassium content determined by flame photometer method (Jackson, 1973). Protein content was determined by Kjeldahl's method (Piper, 1966), methionine and cysteine estimated by spectrophotometric method, calcium content from grains was estimated by EDTA method and sulphur estimated by turbidity method (Chesnin and Yien, 1951). Grain yield also recorded after harvest of chickpea.

RESULTS AND DISCUSSION

Uptake of nutrients as influenced by various practices

Total uptake of nitrogen kg ha⁻¹

The results of total uptake of nutrients are presented in Table 1-2. The highest total uptake of N (106.72 kg ha⁻¹) was observed in farmers field treated with 34: 67.5: 0 NPK kg ha⁻¹ under irrigation condition, whereas, lowest uptake of N (47.73 kg ha⁻¹) was obtained with lower dose of N (12.5 kg ha⁻¹) + FYM @ 8 t ha⁻¹. The application of chemical fertilizer under irrigation was increased total uptake of N by 34.27 per cent (on the basis of mean value of N uptake) over imbalance amount of chemical fertilizer + residual moisture (category I). Similarly, total uptake of N was increased by 32.09 per cent with practice of integrated nutrient management + irrigations over the application of chemical fertilizers + various organic doses + residual moisture (on the basis of mean value of N uptake). Mane *et al.* (2020) reported that the application of 25:50:30 NPK kg ha⁻¹ along with 2 foliar spray of KNO₃ @ 1% at flowering and pod formation stage showed synergistic effect on total uptake of N, P and K nutrients.

Total uptake of phosphorus kg ha⁻¹

Data in respect of total uptake of P by chickpea as affected by different nutrient management practices and irrigation condition are summarized in Table 1-2. The application of integrated nutrient management in residual moisture was increased the total uptake of P by 14.57 per cent (on mean basis) over the application of chemical fertilizer in residual moisture condition. Similarly, the total uptake of P was increased by 7.50 per cent with the practices of integrated nutrient management over chemical fertilizer under irrigation condition. Whereas, the total uptake of P was increased by 40.02 per cent with the application of chemical fertilizer + irrigations over the applications of chemical fertilizers + residual moisture condition. Kumar *et al.* (2016) quoted that application of 80 kg P₂O₅ ha⁻¹ resulted in high uptake in grain (9.91 kg ha⁻¹). The highest total uptake of P (22.46 kg ha⁻¹) was observed in the farmers field treated with 34:67.5:00 NPK kg ha⁻¹ + FYM @ 10 t ha⁻¹ under irrigated condition, whereas lowest uptake of P (8.45 kg ha⁻¹) was obtained with the application of 11.5:0:0 NPK kg ha⁻¹ + FYM @ 8 t ha⁻¹, under residual moisture condition. The total uptake of P indicates with increasing level of P fertilizer.

Total uptake of potassium kg ha⁻¹

Potassium actively involved activation of various enzymes, protein synthesis, carbohydrate metabolism and direct bearing of seed production. Data in respect of total uptake of K by chickpea as affected by different nutrient management practices and irrigation condition are summarized in Table 1-2. The highest uptake of potassium was observed in the integrated nutrient management + irrigation practices under category IV (64.67 kg ha⁻¹). Gaud *et al.* (2014) showed highest uptake of K (39 kg K₂O ha⁻¹) with the application 40 kg K₂O ha⁻¹. Similarly, Kumar *et al.* (2017) recorded increase in total uptake of K (72.02 kg ha⁻¹) with the increasing level of potassium in pigeonpea significantly. Jadeja *et al.* (2019) reported that the potassium uptake in seed of chickpea increased significantly with the application of 80 kg K₂O ha⁻¹. The uptake of potassium in seed (26.37 kg ha⁻¹) was highest over control (21.60 kg ha⁻¹).

Nutritional quality of chickpea

Data in respect of nutritional quality of chickpea as affected by different nutrient management practices are summarized in Table 3-4. From the data, the highest protein (21.88%) of chickpea grain was recorded with the application of 34:67.5:0 NPK kg ha⁻¹ in combination with FYM @ 10 t ha⁻¹ under irrigation condition. Lende and Patil (2017) stated that irrigation to chickpea gave higher protein content (23.80%) than non irrigated plot (22.56%). The maximum value of S (0.53%) and cysteine (1.43 g 100g⁻¹ N) in chickpea grain was obtained under category IV (INM+irrigation) with the application of 22.5 :67.5 :37.5 + FYM @ 5 t ha⁻¹ along with one irrigation and highest Ca (0.36%) and methionine content (1.82 g 100g⁻¹ N) was observed under category IV with dose of 22.5:67.5 :37.5 NPK kg ha⁻¹ along with vermicompost @ 2 t ha⁻¹.

Yield of chickpea

The data pertaining to grain yield of chickpea as affected by different practices are depicted in Table 3-4. The data clearly indicated that the yield of chickpea was influenced due to application of integrated nutrient management practices under irrigation conditions. The grain yield of chickpea was enhanced by 13.53 and 10.99 per cent (on the basis of mean value) with the practices of integrated nutrient management + residual moisture and integrated nutrient management + irrigations, respectively over the application of chemical fertilizer + residual moisture and chemical fertilizer + irrigations at flowering and pod formation stage, respectively. Similarly 32.35 and 30.37 per cent grain yield was increased with integrated nutrient management practices under residual moisture and irrigations over the application of chemical fertilizers + residual moisture and chemical fertilizer + irrigations, respectively. Asefa and Wagari (2021) reported that combined application of 75 kg NPS ha⁻¹ was recorded the highest yield (2537 kg ha⁻¹). Singh *et al.* (2017) observed that the grain yield was enhanced of 17.99 q ha⁻¹ with irrigation at flowering and pod formation stage than non irrigated plot (14.33 q ha⁻¹).

Table 1. Total uptake of nutrients kg ha⁻¹ as affected by different chemical fertilizers and integrated nutrient management (on residual moisture)

| Locations | Fertilizers applied | Total N uptake kg ha ⁻¹ | Total P uptake kg ha ⁻¹ | Total K uptake kg ha ⁻¹ |
|--|---|------------------------------------|------------------------------------|------------------------------------|
| Category I – Chemical fertilizers (on residual moisture) | | | | |
| Jawala | 80:57.5:0 NPK kg ha ⁻¹ | 64.18 | 12.2 | 36.74 |
| Jawala | 13.5:35.5:0 NPK kg ha ⁻¹ | 50.85 | 10.49 | 30.44 |
| Kondwardha | 57.5:0:0 NPK kg ha ⁻¹ | 50.32 | 9.37 | 27.74 |
| Jainpur | 22.5:67.5:0 NPK kg ha ⁻¹ | 57.03 | 12.21 | 32.89 |
| Jainpur | 22.5:32.5:32.5 NPK kg ha ⁻¹ | 53.09 | 9.37 | 31.96 |
| | Range | 50.32 -64.46 | 9.37-12.21 | 27.74 -36.74 |
| | Mean | 55.09 | 10.73 | 31.95 |
| Category II – Integrated nutrient management (on residual moisture) | | | | |
| Thugaon | 22.5:67.5:37.5 NPK kg ha ⁻¹ + 5 t ha ⁻¹ FYM | 72.43 | 14.69 | 40.98 |
| Jainpur | 22.5:67.5:0 NPK kg ha ⁻¹ + + Humic acid | 62.69 | 13.01 | 40.64 |
| Pimpri | 22.5:67.5:37.5 NPK kg ha ⁻¹ + 2 t ha ⁻¹ VC | 77.99 | 15.05 | 40.34 |
| Shirala | 11.5:0:0 NPK kg ha ⁻¹ + 8 t ha ⁻¹ FYM | 47.73 | 8.45 | 29.77 |
| Shirala | 28:5:0:3.25 NPKS kg ha ⁻¹ + 8 t ha ⁻¹ FYM | 66.91 | 11.59 | 43.19 |
| | Range | 47.73- 77.99 | 8.45- 15.05 | 29.77- 43.19 |
| | Mean | 65.55 | 12.56 | 38.98 |

Table 2. Total uptake of nutrients kg ha⁻¹ as affected by different chemical fertilizers and integrated nutrient management under irrigated condition

| Locations | Fertilizers applied | Irrigations | Total N uptake kg ha ⁻¹ | Total P uptake kg ha ⁻¹ | Total K uptake kg ha ⁻¹ |
|--|--|-------------|------------------------------------|------------------------------------|------------------------------------|
| Category III – Chemical fertilizers (irrigated) | | | | | |
| Jawala | 12.5:32.5:32.5 NPK kg ha ⁻¹ | 1 | 78.2 | 14.66 | 48.0 |
| Jawala | 22.5:67.5:37.5 NPK kg ha ⁻¹ | 2 | 83.15 | 18.24 | 54.85 |
| Kondwardha | 80:67.5:0 NPK kg ha ⁻¹ | 1 | 96.48 | 20.07 | 48.99 |
| Jainpur | 22.5:67.5:0 NPK kg ha ⁻¹ | 1 | 78.2 | 17.3 | 46.44 |
| Jainpur | 22.5:67.5:0 NPK kg ha ⁻¹ + MKP | 1 | 83.08 | 19.2 | 51.89 |
| | Range | | 78.2- 96.48 | 14.66-20.07 | 46.44- 54.85 |
| | Mean | | 83.82 | 17.89 | 50.03 |
| Category IV –Integrated nutrient management (irrigated) | | | | | |
| Thugaon | 22.5:67.5:37 NPK kg ha ⁻¹ + 5 t ha ⁻¹ FYM | 1 | 92.06 | 19.9 | 59.27 |
| Kondwardha | 57.5:0:0 NPK kg ha ⁻¹ + 0.25 t ha ⁻¹ Neem cake | 1 | 97.77 | 17.49 | 59.71 |
| Thugaon | 22.5:67.5:37.5 NPK kg ha ⁻¹ + 2 t ha ⁻¹ VC | 2 | 91.07 | 19.96 | 58.59 |
| Pimpri | 57.5:0:0 NPK kg ha ⁻¹ + Subabul 2 t ha ⁻¹ | 1 | 95.05 | 16.9 | 56.71 |
| Shirala | 34:67.5:0 NPK kg ha ⁻¹ + 10 t ha ⁻¹ FYM | 1 | 106.72 | 22.46 | 64.67 |
| | Range | | 91.07- 106.72 | 16.9- 22.46 | 56.71- 64.67 |
| | Mean | | 96.53 | 19.34 | 59.79 |

Table 3. Nutritional value of chickpea as affected by different chemical fertilizers and integrated nutrient management (on residual moisture)

| Category - I Chemical fertilizers (on residual moisture) | | | | | | |
|---|---|--------------|---|--------------------------------------|-----------|-----------|
| Locations | Fertilizer doses (NPK kg ha ⁻¹) | Grain sample | | | | |
| | | Protein (%) | Methionine (g 100 g ⁻¹ of N) | Cysteine (g 100g ⁻¹ of N) | Ca (%) | S (%) |
| Jawala | 80: 57.5: 0 | 20.13 | 1.45 | 1.37 | 0.32 | 0.38 |
| Jawala | 13.5:35.5: 0 | 19.31 | 1.47 | 1.35 | 0.28 | 0.26 |
| Kondwardha | 57.5: 0: 0 | 19.69 | 1.39 | 1.31 | 0.28 | 0.27 |
| Jainpur | 22.5:67.5: 0 | 19.06 | 1.42 | 1.30 | 0.28 | 0.32 |
| Jainpur | 12.5:32.5: 32.5 | 19.44 | 1.53 | 1.32 | 0.31 | 0.37 |
| | Range | 19.06-20.13 | 1.39-1.53 | 1.30- 1.37 | 0.28-0.32 | 0.26-0.38 |
| | Mean | 19.53 | 1.45 | 1.33 | 0.29 | 0.32 |
| Category - II Integrated nutrient management (on residual moisture) | | | | | | |
| Thugaon | 22.5: 67.5: 37.5+ FYM- 5 t ha ⁻¹ | 21.06 | 1.60 | 1.30 | 0.29 | 0.36 |
| Jainpur | 22.5: 67.5: 0+ Humic acid | 19.06 | 1.42 | 1.29 | 0.28 | 0.34 |
| Pimpri | 22.5: 67.5: 37.5+ FYM- 2 t ha ⁻¹ | 21.19 | 1.47 | 1.35 | 0.29 | 0.35 |
| Shirala | 11.5: 0: 0+ FYM- 8 t ha ⁻¹ | 18.63 | 1.64 | 1.39 | 0.24 | 0.42 |
| Shirala | 28 : 5: 0: 3.25+ FYM- 8 t ha ⁻¹ | 19.5 | 1.76 | 1.35 | 0.28 | 0.38 |
| | Range | 18.63-21.19 | 1.42-1.76 | 1.29-1.39 | 0.24-0.29 | 0.34-0.42 |
| | Mean | 19.89 | 1.58 | 1.34 | 0.28 | 0.37 |

Table 4. Nutritional value of chickpea as affected by different chemical fertilizers and integrated nutrient management under irrigated condition

| Category - III Chemical fertilizers (irrigated) | | | | | | | |
|--|--|-----------------------|---------------|--|--|-----------|-----------|
| Locations | Fertilizer doses (NPK kg ha ⁻¹) | No. of irrigations | Grain sample | | | | |
| | | | Protein (%) | Methionine (g 100 g ⁻¹ of N) | Cysteine (g 100 g ⁻¹ of N) | Ca (%) | S (%) |
| Fubgaon | 12.5: 32.5: 32.5 | 1 | 19.75 | 1.76 | 1.40 | 0.35 | 0.31 |
| Kondwardha | 22.5: 67.5: 37.5 | 2 | 19.44 | 1.62 | 1.37 | 0.30 | 0.33 |
| Shirala | 80: 67.5: 0 | 1 | 21.13 | 1.50 | 1.43 | 0.34 | 0.40 |
| Madhan | 22.5: 67.5: 0 | 1 | 19.25 | 1.68 | 1.41 | 0.35 | 0.35 |
| Jainpur | 22.5:67.5:0 +MKP | 1 | 19.25 | 1.45 | 1.39 | 0.29 | 0.32 |
| | Range | | 19.25 – 21.13 | 1.45-1.76 | 1.37-1.43 | 0.29-0.34 | 0.31-0.40 |
| | Mean | | 19.76 | 1.60 | 1.4 | 0.33 | 0.34 |
| Category - IV Integrated nutrient management (irrigated) | | | | | | | |
| Thugaon | 22.5: 67.5: 37.5+ FYM- 5 t ha ⁻¹ | 1 | 19.63 | 1.66 | 1.43 | 0.32 | 0.53 |
| Kondwardha | 57.5: 0: 0+ Neem cake- 0.25 tha ⁻¹ | 1 | 20.13 | 1.53 | 1.32 | 0.28 | 0.35 |
| Thugaon | 22.5: 67.5: 37.5+ VC- 2 t ha ⁻¹ | 2 | 19.81 | 1.82 | 1.41 | 0.36 | 0.42 |
| Pimpari | 57.5: 0: 0+ Subabul – 2 t ha ⁻¹ | 1 | 20.56 | 1.37 | 1.29 | 0.30 | 0.34 |
| Shirala | 34: 67.5: 0+ FYM- 10 t ha ⁻¹ | 1 | 21.90 | 1.67 | 1.33 | 0.35 | 0.42 |
| | Range | | 19.63- 21.90 | 1.37-1.82 | 1.29-1.43 | 0.28-0.36 | 0.34-0.53 |
| | Mean | | 20.40 | 1.61 | 1.36 | 0.32 | 0.41 |

Table 5. Grain and straw yield of chickpea as influenced by chemical fertilizers and integrated nutrient management (on residual moisture)

| Category I – Chemical fertilizers (on residual moisture) | | | | |
|--|---|----------------------------------|----------------------------------|----------------------------------|
| Locations | Inorganic fertilizers(NPK kg ha ⁻¹) | Grain yield(q ha ⁻¹) | Straw yield(q ha ⁻¹) | |
| Jawala | 80: 57.5: 0 | 13.0 | 16.77 | |
| Jawala | 13.5: 35.5: 0 | 11.0 | 14.41 | |
| Kondwardha | 57.5: 0: 0 | 10.5 | 13.68 | |
| Jainpur | 22.5: 67.5: 0 | 12.0 | 15.84 | |
| Jainpur | 12.5: 32.5: 32.5 | 11.0 | 14.52 | |
| | Range | 10.5 – 13.0 | 13.68-16.77 | |
| | Mean | 11.5 | 15.04 | |
| Category II – Integrated nutrient management (on residual moisture) | | | | |
| Locations | Inorganics(NPK kg ha ⁻¹) | Organics(t ha ⁻¹) | Grain yield(q ha ⁻¹) | Straw yield(q ha ⁻¹) |
| Thugaon | 22.5:67.5: 37.5 | FYM- 5 t ha ⁻¹ | 14.5 | 18.85 |
| Jainpur | 22.5: 67.5: 0 | Humic acid | 13.5 | 18.23 |
| Pimpari | 22.5:67.5: 37.5 | VC – 2 t ha ⁻¹ | 15.0 | 20.25 |
| Shirala | 11.5: 0: 0 | FYM- 8 t ha ⁻¹ | 10.0 | 13.9 |
| Shirala | 28 : 5: 0: 3.25 | FYM- 8 t ha ⁻¹ | 13.5 | 18.23 |
| | Range | 10.0 – 15.0 | 13.9 –20.25 | |
| | Mean | | 13.3 | 17.89 |

Table 6. Grain and straw yield of chickpea as influenced by chemical fertilizers and integrated nutrient management under irrigate conditions.

| Category III – Chemical fertilizers (irrigated) | | | | |
|--|---|-------------|--------------------------------------|--------------------------------------|
| Locations | Fertilizer doses (NPK kg ha ⁻¹) | Irrigations | Grain yield (q ha ⁻¹) | Straw yield (q ha ⁻¹) |
| Fubgaon | 12.5: 32.5: 32.5 | 1 | 16.0 | 21.76 |
| Kondwardha | 22.5: 67.5: 37.5 | 2 | 17.0 | 23.29 |
| Shirala | 80: 67.5: 0 | 1 | 18.5 | 25.53 |
| Madhan | 22.5: 67.5: 0 | 1 | 16.5 | 22.44 |
| Jainpur | 22.5: 67.5: 0 +MKP | 1 | 17.0 | 23.63 |
| | Range | | 16 – 18.5 | 21.76-25.53 |
| | Mean | | 17.0 | 23.33 |
| Category IV– Integrated nutrient management (irrigated) | | | | |
| Thugaon | 22.5:67.5: 37.5+FYM- 5 t ha ⁻¹ | 1 | 18.5 | 25.16 |
| Kondwardha | 22.5: 67.5: 0+Neem cake-0.25 t ha ⁻¹ | 1 | 19.5 | 26.91 |
| Thugaon | 22.5:67.5: 37.5+VC- 2 t ha ⁻¹ | 2 | 18.5 | 25.53 |
| Pimpari | 11.5: 0: 0+Subabul- 2 t ha ⁻¹ | 1 | 19.0 | 26.03 |
| Shirala | 28 : 5: 0: 3.25+FYM – 10 t ha ⁻¹ | 1 | 20.0 | 27.2 |
| | Range | | 18.5 -20.0 | 25.16-27.2 |
| | Mean | | 19.10 | 26.17 |

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