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# Effect of zinc and iron on nutrient content, uptake and quality of chickpea *(Cicer arietinum L.)*

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**Abstract**

A field experiment was conducted at Research Farm, Vivekananda Global University, Jaipur during Rabi season, 2023-24 on loamy sand soil. The experiment comprises eight levels of micronutrients (Control, Soil application of Zinc@5 kg/ha, Soil application of Iron@5 kg/ha, Soil application of Zinc@5 kg/ha + Iron@5 kg/ha at flower initiation, Control + 0.5 % Fe + Zn spray at flower initiation, Soil application of Zinc@5 kg/ha + 0.5 % Fe + 0.5% Zn spray at flower initiation, Soil application of Iron@5 kg/ha + 0.5 % Fe + 0.5% Zn spray at flower initiation and Soil application of Zinc@5 kg/ha + Iron@5 kg/ha at flower initiation + 0.5 % Fe + 0.5% Zn spray at flower initiation) thereby making 8 treatment combinations was laid out in randomized block design and replicated thrice. Results showed that application of treatment F8 (Soil application of Zinc@5 kg/ha + Iron@5 kg/ha at flower initiation + 0.5 % Fe + 0.5% Zn spray at flower initiation) significantly increased the content of Zn and Fe in seed and stover and their uptake. Highest protein content in grain (22.85 %) of chickpea and yield (413.58 kg ha-1) per hectare recorded with the application of F8 (Soil application of Zinc @ 5 kg ha-1 + Iron @ 5 kg ha-1 at flower initiation + at 0.5% Fe + 0.5% Zn spray at flower initiation) over all other treatments.

**Keyword:** Iron, nutrient, quality, uptake and zinc

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## Introduction

Chickpea (Cicer arietinum L.) is crop grown in most of the rainfed areas in our country and mostly in Rajasthan during Rabi season. It is cultivated because of its low cost of cultivation. It is a legume crop with assured income generation and a source of soil fertility build up through nitrogen incorporation. Worldwide, more than two billion of people or one in every three persons is spotted to be troubled with multiple micronutrient deficiencies. Growing children are grievously affected by nutrient deficiencies compared to adults, as their nutrients requirement changes according to growth and developmental phages. Malnutrition caused by vitamins and minerals is also known as "Hidden hunger", which don't give any visual symptom usually. Micronutrient deficiencies are the fountainhead of various health issues like poor neurological function, impaired eye sight, diabetes, hypertension, week immunity, and diarrhea, food allergies, thinning hair, leaky gut, acne or rashes. Those deficiencies are attributable to low intake of quality diet riched with proteins, vitamins and minerals.

The foliar spray of micro-nutrients was found to have beneficial effect on enhancing growth and increasing seed yield. Zinc sulphate is applied as basal as well as foliar. It is needed by plants in small amounts, but yet crucial to plant development. In plants, zinc is key constituent of many enzymes and proteins. It is essential in the formation of auxins, which help with growth regulation and stem elongation. Growth parameters were increased by zinc application regardless to its concentration and application method. Zinc application either through soil or foliar application, also increases the Zn content of shoot [1]. Foliar sprays fix the problem for the plant but they have don't fix the problem in the soil.

Iron is very important to the growth of plants. It is a constituent of several enzymes and some pigments, and assists in nitrate and sulphate reduction and energy production within plant. Although iron is not used in the synthesis of chlorophyll but it is essential for its formation. Iron plays a significant role in various physiological and biochemical

pathway in plants. In plants, iron is involved in the synthesis of chlorophyll and it is essential for the maintenance of chloroplast structure and function.

## Material and Methods

The experiment comprises eight levels of micronutrients (Control, Soil application of Zinc@5 kg/ha, Soil application of Iron@5 kg/ha, Soil application of Zinc@5 kg/ha + Iron@5 kg/ha at flower initiation, Control + 0.5 % Fe + Zn spray at flower initiation, Soil application of Zinc@5 kg/ha + 0.5 % Fe + 0.5% Zn spray at flower initiation, Soil application of Iron@5 kg/ha + 0.5 % Fe + 0.5% Zn spray at flower initiation and Soil application of Zinc@5 kg/ha + Iron@5 kg/ha at flower initiation + 0.5 % Fe + 0.5% Zn spray at flower initiation) thereby making 8 treatment combinations was laid out in randomized block design and replicated thrice.

### Treatment application

Application of 5 kg ha-1 zinc and 5 kg ha-1 iron at the time of field preparation as basal dose and foliar application of Zinc (0.5%) and iron (0.5%) was done at flower initiation stage with the help of foot sprayer.

### Nutrient content, uptake and quality attributes

Zinc: Zinc was estimated using wet digestion of plant with diacid (HNO3 and HCLO4 in ratio of 9:4) and was analyzed with the help of AAS [2]. Iron: Iron was estimated using wet digestion of plant with diacid (HNO3 and HCLO4 in ratio of 9:4) and was analyzed with the help of AAS ([2]. Nutrient uptake; Then nutrient uptake by crop was calculated by multiplying the per cent nutrient content in grain and straw with their respective dry matter yield and expressed as kg/ha.

### Protein content and yield

The crude protein content in grain was calculated by multiplying the nitrogen percentage in grain with a factor 6.25 (A.O.A.C., 1975). The result was expressed as percent protein content on dry weight basis.

### Statistical analysis

In order to test the significance of variation in experimental data obtained for various treatment effects, the data were statistically analyzed as described by Fisher (1950). The critical differences were calculated to assess the significance of treatment mean wherever the F' test was found significant at 5 per cent level of probability. To elucidate the nature and magnitude of treatment effects, summary tables along with SEm+ and CD (P=0.05) were prepared and are given in the text of the chapter. Experimental results and their analyses of variance are given in Appendices at the end.

## Results and Discussion

A perusal of data (Table 1) shows that the nutrient content and uptake of chickpea crop significantly influenced with the application of different treatments of zinc and iron fertilizers investigation. Results indicated that the application of zinc and iron in combination as F8 (Soil application of Zinc@5 kg/ha + Iron@5 kg/ha at flower initiation + 0.5 % Fe + 0.5% Zn spray at flower initiation) improved the nutrients contents viz., zinc and iron in chickpea seed and stover which closely followed by treatment F6 (Soil application of Zinc@5 kg/ha + 0.5 % Fe + 0.5% Zn spray at flower initiation) and F7 (Soil application of Iron@5 kg/ha + 0.5 % Fe + 0.5% Zn spray at flower initiation). Further data on uptake shows that the same treatment recorded highest uptake of zinc with the respective values in seed 53.00 g ha-1and in stover 59.69 g ha-1 and iron in seed 158.76 g ha-1and 175.70g ha-1, respectively. The more absorption of zinc and iron through foliar nutrition to fulfill the unmet requirement of these nutrients from source to sink and thereby more content and uptake of these nutrients were recorded in the foliar treatment supplemented with soil application. These results of showing increment in nutrient content and uptake are in line with those earlier reported by [5]. The use of micronutrients in a variety of pulses has boosted the concentration of nutrients in grains. The findings agree with those of [6] who discovered that Zn, B, and Mo significantly boosted chickpea and lentil straw yield.

Results further indicated that the application of zinc and iron in combination as F8 (Soil application of Zinc@5 kg/ha + Iron@5 kg/ha at flower initiation + 0.5 % Fe + 0.5% Zn spray at flower initiation) increased the protein content in

Table 1 Effect of zinc and iron on nutrient content and uptake in seed and stover of chickpea

| Treatments | Fe content (ppm) | | Fe uptake (g ha$^{-1}$) | | Zn content (ppm) | | Zn uptake (g ha$^{-1}$) | | Protein content | Protein yield (kg ha$^{-1}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| | Seed | Stover | Seed | Stover | Seed | Stover | Seed | Stover | | |
| Control | 78.06 | 62.70 | 101.47 | 125.34 | 25.04 | 20.35 | 32.60 | 40.69 | 20.81 | 311.50 |
| Soil application of Zinc@5 kg/ha | 83.77 | 65.65 | 125.38 | 144.25 | 27.36 | 21.73 | 40.94 | 47.74 | 21.56 | 331.31 |
| Soil application of Iron@5 kg/ha | 84.64 | 66.69 | 130.05 | 149.15 | 27.86 | 22.09 | 42.80 | 49.40 | 21.31 | 323.94 |
| Soil application of Zinc@5 kg/ha + Iron@5 kg/ha at flower initiation | 84.25 | 668.48 | 128.05 | 147.58 | 27.71 | 21.96 | 42.11 | 48.74 | 21.10 | 331.35 |
| Control + 0.5 % Fe + 0.5 % Zn spray at flower initiation | 84.01 | 65.72 | 131.90 | 149.18 | 27.53 | 21.90 | 43.22 | 49.71 | 22.04 | 381.03 |
| Soil application of Zinc@5 kg/ha + 0.5 % Fe + 0.5% Zn spray at flower initiation | 86.53 | 67.34 | 149.72 | 163.66 | 28.68 | 22.70 | 49.63 | 55.16 | 21.71 | 366.74 |
| Soil application of Iron@5 kg/ha + 0.5 % Fe + 0.5% Zn spray at flower initiation | 86.02 | 67.30 | 145.37 | 160.84 | 28.17 | 22.46 | 47.61 | 53.67 | 22.85 | 413.58 |
| Soil application of Zinc@5 kg/ha + Iron@5 kg/ha at flower initiation + 0.5 % Fe + 0.5% Zn spray at flower initiation | 87.72 | 68.19 | 158.76 | 175.70 | 29.29 | 23.16 | 53.00 | 59.69 | 20.42 | 263.35 |
| SEm± | 0.90 | 0.49 | 5.12 | 5.94 | 0.31 | 0.13 | 1.74 | 1.96 | 0.42 | 9.86 |
| CD (P=0.05) | 2.74 | 1.48 | 15.54 | 18.03 | 0.93 | 0.39 | 5.27 | 5.94 | 1.28 | 29.91 |

chickpea seed. Highest protein content in grain (22.85 %) of chickpea and yield (413.58 kg ha-1) per hectare recorded with the application of F8 (Soil application of Zinc @ 5 kg ha-1 + Iron @ 5 kg ha-1 at flower initiation + at 0.5% Fe + 0.5% Zn spray at flower initiation) over all other treatments. However, incorporating Zn into seeds may result in a large boost in protein production [7]. The combined application of Zn and Fe at the dose of 0.5% each had significant effect on crude protein content of chickpea grains [8]. Protein synthesis and protein levels are markedly reduced in Zn deficient plants, but amino acids and amides are accumulated, as Zn is the structural component of the protein synthesizing polymerase enzyme. Hence, in Zn deficient plants, the protein synthesis of Ribonucleic Acid ceases [9].

**Conclusion**

Based on the results of one year study it may be concluded that treatment F8 (Soil application of Zinc @ 5 kg ha-1 + Iron @ 5 kg ha-1 at flower initiation + at 0.5% Fe + 0.5% Zn spray at flower initiation) was found better with respect significantly increased the content of Zn and Fe in seed and stover and their uptake and highest protein content in grain (22.85 %) of chickpea and yield (413.58 kg ha-1) per hectare.

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