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Effect of Iron and Zinc Levels on Growth and Yield of Chickpea (*Cicer arietinum* L.)

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A B S T R A C T

The field experiment was conducted during rabi season comprised of ten treatments *viz.* with Iron at 3.0,4.5and 6.0 kg/ha, Zinc 2.0,3.0 and 4.0 kg/ha and control (20:40:20) NPK kg/ha. And the experiment was laid out in Randomized Block Design. Application of Iron and Zinc significantly influenced the growth parameters, yield attributing characters and yield over control. Application of 6 kg $FeSO_4$ + 4 kg $ZnSO_4$ recorded highest Plant height (43.33 cm), Number of nodules (29.75), Number of branches (11.25) per plant and Dry weight (18.41 g), whereas, application of 6 kg $FeSO_4$ + 3 kg $ZnSO_4$. recorded maximum seed yield (2457.15 kg/ha) and Benefit cost ratio (2.17).

Introduction

Chickpea (*Cicer arietinum* L.) belongs to the genus *Cicer* species *arietinum* and family *fabaceae.* It is an important cool season pulse crop and is also called as Bengal gram. In terms of pulse production, India contributes about 25% to the global pulses production (Pooniya and Pithia, 2015). In India Chickpea is premier pulse crop grown on an area of 106 lakhs/ha during 2017-18. India harvested a record production of more than 112 lakh tons with productivity of 1063 kg/ha. The main chickpea producing states are Madhya Pradesh, Rajasthan, Maharashtra, Andhra Pradesh and Uttar Pradesh has cultivated an area of 5.01 Lakh/ ha and contributed 5.79 l/ha production (MoA 2017-2018).

Iron is the most important micronutrient for chickpea crop. It plays a crucial role in redox system in cell and various enzymes. Dicotyledons and graminaceous plants have different strategies to acquire iron (Marschner, 2012). Iron (F_e) is present at high quantities in soils but its availability to plants is usually low and therefore F_e deficiency is common problem (Nozoye *et al.*, 2011). It helps in formation of chlorophyll and its an important constituent of enzyme nitrogenase, which is essential for nitrogen fixation. It has an essential role in nucleic acid metabolism. It

activates number of enzymes, including aminolevolinic acid synthetase and coproporphyrinagen oxidase and a structural component of hemes, hematin, and leg hemoglobin.

Zinc plays an important role in formation of chlorophyll and growth hormones. It also essential plant nutrient for plant growth and development. Zn also plays an important role in protein synthesis and nucleic acid and helps in utilization of N and P by plants. It also associated with water uptake and retention in the plants. Zn nutrient is receiving substantial attention as application of zinc in many legumes has also been found to increase nodulation, N fixation and yield. About 49% of Indian soils are deficient in zinc and response to zinc application has been reported for a number of crops including chickpea (Katyal *et al.,* 2004 and Tripathi *et al.,* 1997). Chickpea is generally considered sensitive to Z_n deficiencyal though there are differences in sensitivity to zinc deficiency between varieties. Z_n deficiency decreases crop yield and delays crop maturity. Also reduces water use and water use efficiency (Khan *et al.,* 2003) and also reduces nodulation and N-fixation (Ahlawat *et al.,* 2007). Zinc deficiency may be observed in calcareous soils. This element can be toxic under high concentrations (Nan *et al.,* 2002). Zn being an essential micronutrient taken active part in metabolic activities of plants and is directly or indirectly required by several enzymatic systems auxin, protein synthesis, seed production, and rate of maturity.

Materials and Methods

The experiment was carried out during *Rabi* season of 2019 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P).The soil of the experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.2), low in organic carbon (0.58%), medium in available N (238 Kg/ha), high in available P (32.10 Kg/ha) and low in available K (189 Kg/ha). The treatment consisting of 3 levels of Iron *viz.* (3.0, 4.5, 6.0) kg/ha and 3 levels of Zinc *viz.* (2.0, 3.0, 4.0) kg/ha. There are 10 treatments each replicated thrice. The experiment was laid out in Randomized Block Design. It was sown on 26thNovember 2019 with spacing 30cm x 10 cm. and followed by Line sowing and Recommended doses of Nitrogen, Phosphorous and Potassium was applied.

Results and Discussion

Growth parameters

Plant height

Chickpea crop with application of 6 Kg $FeSO_4$ /ha along with4 Kg $ZnSO_4$ /ha resulted highest plant height (43.33 cm) at 80 DAS. The increase in the availability of iron to plant might have stimulated the metabolic and enzymatic activities thereby increasing the growth of the plant reported by (Trivedi *et al.,* 2011).Zinc application influence on synthesis of auxin which enhance the plant growth and development of crop (Kasthurikrishna and Ahlawat, 2000).

Number of nodules/Plant

Chickpea crop with application of 6 Kg $FeSO_4$ /ha along with 4 Kg $ZnSO_4$ /ha resulted highest number of nodules per plant (29.75).Iron is important in nodule nitrogen fixation and is a component of key proteins such as nitrogenase, leg haemoglobin and ferredoxin. Deficiencies of mineral nutrients may limit symbiotic nitrogen fixation in legumes through specific effects on survival and growth of rhizobia in the external media, on nodule initiation, development and nodule function (Loneragan, 1972 and Robson,

1983). (Reisenauer, 1970) reported that inhibition or reduction in nodulation and nitrogen fixation due to Zn deficiency and toxicity by interference in the host and Rhizobium nutrition. (Rai *et al.*, 1982) found that decrease in the nodule number and mass in chickpea due to iron deficiency (Table 1).

Table.1 Effect of iron and zinc on growth and yield attributes of chickpea

TREATMENTS	Plant height (cm) (80 DAS)	Number of Nodules/Plant (80 DAS)	Dry weight (g) (80 DAS)	Seed yield (kg/ha)	B:C Ratio
(20-40-20) NPK kg/ha	39.99	13.25	14.23	2005.63	1.63
3.0 Kg $FeSO_4$ + 2 Kg $ZnSO_4$	40.55	14.75	16.43	2213.42	1.88
3.0 Kg $FeSO_4$ + 3 Kg $ZnSO_4$	41.94	15.75	17.42	2252.52	1.92
3.0 Kg $FeSO_4$ + 4 Kg $ZnSO_4$	41.54	18.25	17.48	2367.25	2.06
4.5 Kg $FeSO_4$ + 2 Kg $ZnSO_4$	41.67	25.75	17.63	2231.85	1.89
4.5 Kg $FeSO_4$ + 3 Kg $ZnSO_4$	40.2	17.5	17.66	2285.38	1.96
4.5 Kg $FeSO_4$ + 4 Kg $ZnSO_4$	40.27	15.25	17.57	2251.85	1.91
6.0 Kg $FeSO_4$ + 2 Kg $ZnSO_4$	42.33	17.0	16.17	2134.21	1.76
6.0 Kg $FeSO_4$ + 3 Kg $ZnSO_4$	42.88	29.5	18.24	2457.15	**2.17**
6.0 Kg $FeSO_4$ + 4 Kg $ZnSO_4$	43.33	29.75	18.41	2411.97	2.11
Sem+	0.65	1.19	0.19	71.47	-
CD at (P = 0.05)	1.92	3.55	0.57	212.31	-

Dry weight (g)

Chickpea crop with application of 6 Kg $FeSO_4$ /ha along with 4 Kg $ZnSO_4$ /ha resulted highest dry weight (18.41 gm) at 80 DAS, The above results might be due to application of $ZnSO_4$ which influenced the plant vigor through absorption of nutrients at critical stages that enhance the physiological activity of crop and increase the assimilation of photosynthates ultimately increasing the dry matter accumulation. Similar results were also reported by Amanullah (2010).

Yield attributes

Chickpea crop with application of 6 Kg $FeSO_4$ /ha along with 3 Kg $ZnSO_4$ /ha recorded maximum seed yield (2457.15 Kg/ha) and benefit cost ratio was (2.17).Zn application enhances protein and carbohydrates synthesis and their transportation to the site of seed formation. The application of iron sulphate plays an important role in synthesis of chlorophyll and plant growth regulator and also improves photosynthesis and assimilates transportation to sink and finally increases seed yield. Similar results were observed by (Mali *et al.*, 2003) and (Jin *et al.*, 2008).

Successive increase in zinc rates increased benefit cost ratio. This result is in conformity with the work of (Shivay *et al.*, 2014)

In conclusion, it is inferred from the present investigation that application of 6.0 kg iron and 3 Kg/ha zinc can be recommended along with the full doses of nitrogen, phosphorus and potassium for receiving higher growth and yield in Chickpea.

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