Evaluate the Effect of Zinc and Iron on Growth, Yield and Quality of Chickpea

Abstract

The research was lead at the Soil Science Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P. during the *Rabi* season in 2020-21 and 2021-22. The experiment was laid out in Randomized Block Design with sixteen treatments and three replications with four levels of zinc and iron respectively with NPK as an RDF. All plant parameters *i. e.* plant height, number of branches plant^{-1}, number of pods plant^{-1}, number of seeds pod^{-1}, test weight, protein, grain yield and stover yield were found to be significant at C.D @ 5% and best in treatment T_{16}(RDF @ 100 % + Zinc @ 20 kg ha^{-1} + Iron @ 7.5 kg ha^{-1}) as compare with in treatment T_1 [Absolute control (RDF @ 0 % + Zinc @ 0 kg ha^{-1} + Iron @ 0 kg ha^{-1})].

Key words: Zinc, Iron, Chickpea, Plant parameters

Introduction

Chickpea pea (*Cicer arietinum* L.) is the most important ancient pulse crop that naturally grown during rabi in India and cultivated mainly in semi-arid and warm world temperate regions where the temperature is 20-30° C (Reddy, 2009). Chickpea belongs to the Leguminosae family. In nearly 50 countries, more than 90 % of chickpea production coming from Asia (Yadav *et al.*, 2007). Chickpea is very valuable, a good source of the protein and has an essential role in the human diet in developing countries. It contains 22.25 percent protein is three times more than that of cereals.

Chickpea is the highest protein-yielding grain legume. The crop can fix 140 kg N ha^{-1} in a growing season (Rupela and Saxena, 1987). 100 g of chickpea seeds provide 360 calories of energy, 5.2 g of fat, 2.2 g of minerals, and 55 g of carbohydrates. The malic and oxalic acid present in green leaves can to minimize intestinal disorders (Amin *et al.*, 2007). It is also rich in Ca, Fe, niacin, vitamin B, and vitamin- C. Its leaves contain malic acid indicated for stomach ailments and blood purification. It being a pulse crop enriches the soil through symbiotic nitrogen fixation (Dotaniya *et al.*, 2014).

Significant increases in seed yield of chickpea by Zn application were demonstrated (Valenciano *et al.*, 2010). Usually, each tone of chickpea seed yield removes 38 g of Zn from the soil (Ahlawat *et al.*, 2007). Among micronutrients, Zn deficiency seems to be the most widespread (Roy *et al.*, 2006). Zn deficiency is scattered among chickpea-growing regions of

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the world because chickpea is generally considered sensitive to Zn deficiency (Khan *et al.*, 1998). Iron is a structural component of porphyrin molecules, cytochromes, heme, nonheme, ferrichrome, and leghaemoglobin. These substances are involved in oxidation-reduction reactions in respiration and photosynthesis (Havlin *et al.*, 1997).

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Materials and Methods

A field experiment conducted at the Soil Science Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, during the *Rabi* season of two years (2020-21 and 2021-22) growing chickpea *Var*. Sadabahar applied 4 levels of zinc and iron respectively Zinc = 0 kg ha^{-1},6.67 kg ha^{-1}, 13.34 kg ha^{-1}, 20 kg ha^{-1} and Iron = 0 kg ha^{-1}, 2.5 kg ha^{-1}, 5 kg ha^{-1}, 7.5 kg ha^{-1} including RDF for cluster bean = 20:40:20 kg ha^{-1} experiment is lead to observe the plant parameters like that plant height, number of branches $plant^{-1}$, number of pods $plant^{-1}$, number of seeds pod^{-1}, test weight, protein, grain yield and stover yield.

Result and Discussion

A critical perusal of data pertaining in the table 1 and fig. 1 the effect of different levels of Zn and Fe plant height (cm) at different days interval of chickpea in both the years (2020-21 and 2021-22) was found to be significant at C.D @ 5%.The plant height of chickpea was found to be maximum 14.92 cm, 30.14 cm, 38.49 cm and 54.28 cm at 30 DAS, 60 DAS, 90 DAS and at harvest in 2020-21 and 14.96 cm, 30.47 cm, 39.07 cm and 55.09 cm at 30 DAS, 60 DAS, 90 DAS and at harvest in 2021-22 in treatment T_{16} (RDF @ 100 % + Zinc @ 20 kg ha^{-1} + Iron @ 7.5 kg ha^{-1}) and minimum 12.54 cm, 25.33 cm, 32.35 cm and 45.62 cm at 30 DAS, 60 DAS, 90 DAS and at harvest in 2020-21 and 12.58 cm, 25.61 cm, 32.84 cm and 46.30 cm at 30 DAS, 60 DAS, 90 DAS and at harvest in 2021-22 in treatment T_1 [Absolute control (RDF @ 0 % + Zinc @ 0 kg ha^{-1} + Iron @ 0 kg ha^{-1})] respectively. Das *et al.*, (2012); Hossain *et al.*, (2016).

A critical perusal of data pertaining in the table 2 and fig. 2 the effect of different levels of Zn and Fe on plant of chickpea in both the years (2020-21 and 2021-22) was found to be significant at C.D @ 5%.The number of branches $plant^{-1}$ of chickpea was found to be maximum 14.32 in 2020-21 and 14.54 in 2021-22 in treatment T_{16} (RDF @ 100 % + Zinc @ 20 kg ha^{-1} + Iron @ 7.5 kg ha^{-1}) followed by 14.25 in 2020-21 and 14.46 in 2021-22 in treatment T_{15} (RDF @ 100 % + Zinc @ 20 kg ha^{-1} + Iron @ 5 kg ha^{-1}) and minimum 12.04 in 2020-21 and 12.22 in 2021-22 in treatment T_1 [Absolute control (RDF @ 0 % + Zinc @ 0 kg

ha^{-1} + Iron @ 0 kg ha^{-1})] respectively. The number of pods $plant^{-1}$ of chickpea was found to be maximum 115.07 in 2020-21 and 116.79 in 2021-22 in treatment T_{16} (RDF @ 100 % + Zinc @ 20 kg ha^{-1} + Iron @ 7.5 kg ha^{-1}) followed by 114.45 in 2020-21 and 116.16 in 2021-22 in treatment T_{15} (RDF @ 100 % + Zinc @ 20 kg ha^{-1} + Iron @ 5 kg ha^{-1}) and minimum 85.74 in 2020-21 and 87.03 in 2021-22 in treatment T_1 [Absolute control (RDF @ 0 % + Zinc @ 0 kg ha^{-1} + Iron @ 0 kg ha^{-1})] respectively. Deshlahare *et al.*, (2019); Sharma *et al.*, (2019).

The number of seeds $pod^{-1}$of chickpea was found to be maximum 2.18 in 2020-21 and 2.21 in 2021-22 in treatment T_{16} (RDF @ 100 % + Zinc @ 20 kg ha^{-1} + Iron @ 7.5 kg ha^{-1}) followed by 2.17 in 2020-21 and 2.20 in 2021-22 in treatment T_{15} (RDF @ 100 % + Zinc @ 20 kg ha^{-1} + Iron @ 5 kg ha^{-1}) and minimum 1.83 in 2020-21 and 1.86 in 2021-22 in treatment T_1 [Absolute control (RDF @ 0 % + Zinc @ 0 kg ha^{-1} + Iron @ 0 kg ha^{-1})] respectively. The test weight of 1000 seeds (g) of chickpea were found to be maximum 129.18 g in 2020-21 and 131.11 g in 2021-22 in treatment T_{16} (RDF @ 100 % + Zinc @ 20 kg ha^{-1} + Iron @ 7.5 kg ha^{-1}) followed by 128.48 g in 2020-21 and 130.41 g in 2021-22 in treatment T_{15} (RDF @ 100 % + Zinc @ 20 kg ha^{-1} + Iron @ 5 kg ha^{-1}) and minimum 108.57 g in 2020-21 and 110.20 g in 2021-22 in treatment T_1 [Absolute control (RDF @ 0 % + Zinc @ 0 kg ha^{-1} + Iron @ 0 kg ha^{-1})] respectively. Pooja, C. and Sarawad, I. M. (2019); Kharol *et al.*, (2014).

The protein (%) of chickpea were found to be maximum 23.96 % in 2020-21 and 24.44 % in 2021-22 in treatment T_{16} (RDF @ 100 % + Zinc @ 20 kg ha^{-1} + Iron @ 7.5 kg ha^{-1}) followed by 23.76 % in 2020-21 and 24.24 % in 2021-22 in treatment T_{15} (RDF @ 100 % + Zinc @ 20 kg ha^{-1} + Iron @ 5 kg ha^{-1}) and minimum 19.43 % in 2020-21 and 19.82 % in 2021-22 in treatment T_1 [Absolute control (RDF @ 0 % + Zinc @ 0 kg ha^{-1} + Iron @ 0 kg ha^{-1})] respectively. Sharma *et al.*, (2019); Kharol *et al.*, (2014).

A critical perusal of data pertaining in the table 3 and fig. 3 the effect of different levels of Zn and Fe on plant of chickpea in both the years (2020-21 and 2021-22) was found to be significant at C.D @ 5%.The seed yield of chickpea was found to be maximum 14.12 q ha^{-1} in 2020-21 and 14.47 q ha^{-1} in 2021-22 in treatment T_{16} (RDF @ 100 % + Zinc @ 20 kg ha^{-1} + Iron @ 7.5 kg ha^{-1}) followed by 13.28 q ha^{-1} in 2020-21 and 13.61 q ha^{-1} in 2021-22 in treatment T_{14} (RDF @ 100 % + Zinc @ 20 kg ha^{-1} + Iron @ 2.5 kg ha^{-1}) and minimum 7.20 q ha^{-1} in 2020-21 and 7.38 q ha^{-1} in 2021-22 in treatment T_1 [Absolute control (RDF @ 0 % + Zinc @ 0 kg ha^{-1} + Iron @ 0 kg ha^{-1})] respectively. The stover yield of chickpea was found to

be maximum 29.74 q ha^{-1} in 2020-21 and 30.48 q ha^{-1} in 2021-22 in treatment T_{16} (RDF @ 100 % + Zinc @ 20 kg ha^{-1} + Iron @ 7.5 kg ha^{-1}) followed by 29.58 q ha^{-1} in 2020-21 and 30.32 q ha^{-1} in 2021-22 in treatment T_{15} (RDF @ 100 % + Zinc @ 20 kg ha^{-1} + Iron @ 5 kg ha^{-1}) and minimum 23.56 q ha^{-1} in 2020-21 and 24.15 q ha^{-1} in 2021-22 in treatment T_1 [Absolute control (RDF @ 0 % + Zinc @ 0 kg ha^{-1} + Iron @ 0 kg ha^{-1})] respectively. Kachave, T. R. and Kausadikar, H. K. (2018); Kuniya *et al.*, (2019).

Table 1. Effect of different levels of zinc and iron on plant height (cm) at different days interval of chickpea.

Treatments	Plant height (cm)							
	2020-21				2021-22			
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	At harvest
T_1	12.54	25.33	32.35	45.62	12.58	25.61	32.84	46.30
T_2	13.18	26.62	34.00	47.95	13.22	26.92	34.51	48.67
T_3	12.65	25.55	32.64	46.02	12.69	25.83	33.13	46.71
T_4	12.82	25.90	33.08	46.64	12.86	26.18	33.57	47.34
T_5	13.35	26.97	34.44	48.56	13.39	27.26	34.96	49.29
T_6	13.51	27.29	34.86	49.15	13.55	27.59	35.38	49.88
T_7	13.92	28.12	35.91	50.64	13.96	28.43	36.45	51.40
T_8	13.85	27.98	35.73	50.38	13.89	28.28	36.27	51.14
T_9	13.77	27.82	35.53	50.09	13.81	28.12	36.06	50.84
T_{10}	14.29	28.87	36.87	51.98	14.33	29.18	37.42	52.76
T_{11}	14.04	28.36	36.22	51.07	14.08	28.67	36.77	51.84
T_{12}	14.43	29.15	37.23	52.49	14.47	29.47	37.79	53.28
T_{13}	14.76	29.82	38.08	53.69	14.80	30.14	38.65	54.50
T_{14}	14.51	29.31	37.44	52.78	14.55	29.63	38.00	53.58
T_{15}	14.84	29.98	38.29	53.98	14.88	30.31	38.86	54.79
T_{16}	14.92	30.14	38.49	54.28	14.96	30.47	39.07	55.09
F - test	S	S	S	S	S	S	S	S
CD @ 5%	0.60	1.20	1.50	1.77	0.59	1.17	1.71	1.88
S.Ed. (±)	0.30	0.59	0.79	0.87	0.29	0.57	0.84	0.92

Table 2. Effect of different levels of zinc and iron on number of branches plant^{-1}, number of pods plant^{-1},number of seeds pod^{-1},test weight of 1000 seeds (g) and protein (%) of chickpea.

Treatments	Number of Branches Plant^{-1}		Number of Pods Plant^{-1}		Number of Seeds Pod^{-1}		Test Weight of 1000 seeds (g)		Protein (%)	
	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22	2020-21	2021-22
T_1	12.04	12.22	85.74	87.03	1.83	1.86	108.57	110.20	19.43	19.82
T_2	12.65	12.84	101.65	103.17	1.92	1.95	114.11	115.82	20.45	20.86
T_3	12.14	12.33	97.56	99.02	1.85	1.87	109.52	111.17	19.78	20.18
T_4	12.31	12.49	98.87	100.35	1.87	1.90	111.00	112.66	20.25	20.66
T_5	12.82	13.01	102.96	104.50	1.95	1.98	115.58	117.32	20.95	21.37
T_6	12.97	13.16	104.19	105.75	1.97	2.00	116.97	118.72	21.1	21.52
T_7	13.36	13.56	107.35	108.96	2.03	2.06	120.52	122.33	22.04	22.48
T_8	13.30	13.50	106.81	108.42	2.02	2.05	119.91	121.71	21.86	22.30
T_9	13.22	13.42	106.20	107.79	2.01	2.04	119.22	121.01	21.54	21.97
T_{10}	13.72	13.92	110.21	111.86	2.09	2.12	123.72	125.58	22.31	22.76
T_{11}	13.48	13.68	108.28	109.90	2.05	2.08	121.56	123.38	22.18	22.62
T_{12}	13.85	14.06	111.29	112.96	2.11	2.14	124.93	126.81	23.34	23.81
T_{13}	14.17	14.38	113.83	115.54	2.15	2.19	127.79	129.71	22.67	23.12
T_{14}	13.93	14.14	111.90	113.58	2.12	2.15	125.63	127.51	22.84	23.30
T_{15}	14.25	14.46	114.45	116.16	2.17	2.20	128.48	130.41	23.76	24.24
T_{16}	14.32	14.54	115.07	116.79	2.18	2.21	129.18	131.11	23.96	24.44
F - test	S	S	S	S	S	S	S	S	S	S
CD @ 5%	0.56	0.60	4.80	5.29	0.09	0.09	5.11	5.55	1.80	1.56
S.Ed. (±)	0.28	0.29	2.35	2.59	0.04	0.05	2.50	2.72	0.40	0.75

Table 3. Effect of different levels of zinc and iron on grain yield (q ha^{-1}) and stover yield (q ha^{-1}) of chickpea.

Treatments	Grain Yield (q ha^{-1})			Stover Yield (q ha^{-1})	
	2020-21	2021-22		2020-21	2021-22
T_1	7.20	7.38		23.56	24.15
T_2	8.88	9.10		26.27	26.93
T_3	9.09	9.32		25.22	25.85
T_4	9.65	9.89		25.55	26.19
T_5	10.27	10.53		26.61	27.28
T_6	10.04	10.29		26.93	27.60
T_7	11.50	11.79		27.75	28.44
T_8	11.42	11.71		27.61	28.30
T_9	12.33	12.64		27.45	28.14
T_{10}	12.16	12.46		28.48	29.19
T_{11}	12.45	12.76		27.99	28.69
T_{12}	13.15	13.48		28.76	29.48
T_{13}	13.08	13.41		29.42	30.16
T_{14}	13.28	13.61		28.92	29.64
T_{15}	13.05	13.38		29.58	30.32
T_{16}	14.12	14.47		29.74	30.48
F - test	S	S		S	S
CD @ 5%	0.54	0.71		0.97	1.21
S.Ed. (±)	0.26	0.35		0.47	0.59

Fig. 1. Effect of different levels of zinc and iron on plant height (cm) at different days interval of chickpea.

Fig. 2. Effect of different levels of zinc and iron on number of branches plant^{-1}, number of pods plant^{-1}, number of seeds pod^{-1},test weight of 1000 seeds (g) and protein (%) of chickpea.

Fig. 3. Effect of different levels of zinc and iron on grain yield (q ha^{-1}) and stover yield (q ha^{-1}) of chickpea.

Conclusion

According to the results revealed the treatment T_{16} (RDF @ 100 % + Zinc @ 20 kg ha^{-1} + Iron @ 7.5 kg ha^{-1}) was seen to be best for all the plant parameters which is followed by treatment T_{15} (RDF @ 100 % + Zinc @ 20 kg ha^{-1} + Iron @ 5 kg ha^{-1}) and the lowest treatment was T_1 [Absolute control (RDF @ 0 % + Zinc @ 0 kg ha^{-1} + Iron @ 0 kg ha^{-1})]. Which proved that full dose of NPK, Fe and Zn are recommendable to the farmers for increasing seed yield.

Reference

Ahlawat, I. P. S., Gangaiah, B. and Ashraf-zadid, M. (2007) Nutrient management in chickpea. In: Chickpea breeding and management (Yadav, S. S., Redden, R., Chen, W., Sharma, B. Ed.). CAB International, Wallingford, Oxon, United Kingdom, 213-232.

Amin, A. M., Ahmad, A. S., Yin, Y. Y., Yahya, N. and Ibrahim, N. (2007) Extraction, purification and characterization of durian (*Durio zibethinus*) seed gum. *Food Hydrocolloids*, **21(2):** 273-279.

Das, S., Pareek, N., Raverkar, K. P., Chandra, R. and Kaustav, A. (2012) Effectiveness of micronutrient application and Rhizobium inoculation on growth and yield of Chickpea. *Intl. J. Agric. Env. Biotech.*, **5(4):** 445-452.

Deshlahare, H., Banjara, G. P. and Tandon, A. (2019) Effect of bio fortification of zinc and iron on yields attributes of chickpea (*Cicer arietinum* L.) through agronomic intervention.*International Journal of Chemical Studies*; **7(4):** 219-221.

Dotaniya M. L., Meena, V. D. and Das, H. (2014) Chromium toxicity on seed germination, root elongation and coleoptile growth of pigeon pea (*Cajanus cajan*). *Legume Res.*, **37(2):** 225-227.

Havlin, L., John, Beaton, D., Jemes, Tisdde, L. S. and Nelsen, W. L. (1997) Soil fertility and fertilizers. *An introduction to nutrient management sixth edition by practice hall upper saddle river*, New Jersey, 07458.

Hossain, M. D., Hasan, M., Sultana, R. and Bari. A. K. M. (2016) Growth and yield response of chickpea to different levels of boron and zinc. *Fundamental and Applied Agriculture*, **1(2):** 82-86.

Comment [4]: Please note citations styles options for the journal standard.

Kachave, T. R. and Kausadikar, H. K. (2018) Impacts of Foliar Application of Speciality Fertilizers on nutrient uptake of Chickpea (*Cicer arietinum* L.). *International Journal of Chemical Studies*; **6(3):** 1699-1702.

Khan, H. R., McDonald, K. and Rengel, Z. (1998) Chickpea genotypes differ in their sensitivity to Zn deficiency. *Plant and Soil*, **19(8):** 11–18.

Kharol, S., Sharma, M., Purohit, H. S., Jain, H. K., Lal, M. and Sumeriya, H. K. (2014) Effect of sulphur and zinc nutrition on yield, quality and nutrient content and uptake by chickpea (*Cicer arietinum* L.) under agroclimatic zone IVa of Rajasthan. *Environment and Ecology*, **32(4):** 1470-1474.

Kuniya, N., Patel, B. B., Malav, J. K., Chaudhary, N., Pavaya, R. P., Patel, J. K., Kumar, S., Jat, J. R., Patel, D. M., Chaudhary, M. G., Patel, B. T. and Patel, V. R. (2019) Yield and nutrient content and uptake by cluster bean (*Cyamopsis tetragonoloba* L.) as influenced by different levels of sulphur and zinc application under light textured soil. *Journal of Pharmacognosy and Phytochemistry*,**8(3):** 2160-2163.

Pooja, C. and Sarawad, I. M. (2019) Influence of iron and zinc on yield, quality of chickpea and status of iron and zinc in post-harvest soil. *Agric. Sci. Digest.*, **39(1):** 31-35.

Reddy, S. R. (2009) Text book of Agronomy of Field crops. *Kalyani Publishers*, New Delhi, 339-347.

Roy, R. N., finck, A., Blair, G. J. and Tandon, H. L. S. (2006) Plant nutrition for food security. A guide for integrated nutrient management. FAO fertilizer and Plant Nutrition Bulletin 16. Rome, Italy, food and Agriculture Organization of the United Nations.

Rupela, O. P. and Saxena, M. C. (1987) Nodulation and nitrogen fixation in chickpea. Eds. CAB. *International, Wallingford, Oxfordshire, UK.*, 191-206.

Sharma, P., Meena, R. S., Kumar, S., Gurjar, D. S., Yadav, G. S., and Kumar, S. (2019) Growth, yield and quality of cluster bean (*Cyamopsis tetragonoloba*) as influenced by integrated nutrient management under alley cropping system. *Indian Journal of Agricultural Sciences*,**89 (11):** 1876–80.

Valenciano, J. B., Boto, J. A. and Marcelo, V. (2010) Response of chickpea (*Cicer arietinum* L.) yield to zinc, boron and molybdenum application under pot conditions. *Spanish Journal of Agricultural Research*; **8(3):** 797-807.

Yadav, S. S., Redden, R. J., Chen, W. and Sharma, B. (2007) Chickpea Breeding and Management. Oxford-shire, UK: CAB International.

Comment [5]: Please note citations styles options for the journal standard.