Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(5): 1356-1359
Received: 19-07-2019
Accepted: 23-08-2019

Dr. GP Banjara
Department of Agronomy, Indira Gandhi Krishi Vishwavidhyalaya, Raipur, Chhattisgarh, India

Sanjay Kumar Majgahe
Department of Agronomy, Indira Gandhi Krishi Vishwavidhyalaya, Raipur, Chhattisgarh, India

Corresponding Author:
Dr. GP Banjara
Department of Agronomy, Indira Gandhi Krishi Vishwavidhyalaya, Raipur, Chhattisgarh, India

Influence of biofortification of zinc and iron on yield and economics of chickpea (*Cicer arietinum* L.)

Dr. GP Banjara and Sanjay Kumar Majgahe

Abstract
The present investigation "Influence of biofortification of zinc and iron on yield and economics of chickpea *(Cicer arietinum* L.) was carried out during Rabi season in 2016-17 and 2017-18 at Instructional Cum Research Farm of IGKV, Raipur (Chhattisgarh). The soil of experimental field was clayey (*Vertisols*) in texture, locally known as "*Kanhar*" which was low, medium and high in available N, P_2O_5 and K_2O, respectively. The experiment was laid out in Split Plot Design with four replications. The experiment consists of two genotypes and six different nutrient levels treatment combinations. It was found significantly difference between both genotypes and all nutrient levels treatment. The chickpea genotype Indira chana-1was found significantly higher in seed yield, stover yield, harvest index, gross return, net return and B:C Ratio over the genotype Vaibhav during both the years and on mean basis except stover yield (2016-17) and harvest index (2017-18). In all nutrient levels treatment is significantly difference except stover yield during both the years and on mean basis. Treatment RDF (20:50:20) + 0.5% $ZnSO_4$ and 0.1% FeSO4 through foliar application in pre flowering and pod development stage recorded significantly highest in seed yield, stover yield, harvest index, gross return, net return and B:C Ratio over all nutrient levels treatment followed by treatment RDF (20:50:20) + Soil application of $ZnSO_4$ @ 25 kg/ha at basal and lowest in RDF (20:50:20) (Standard control) during both the years and on mean basis.

Keywords: Chickpea, biofortification, zinc and iron, seed yield, economics

Introduction
Pulse produced on 12-13 percent of global arable land. India is the first in the world production and area contributed around 70 percent to the world production. Chickpea grown over 40 countries. Pulses are important source of proteins and it also constituent starch, vitamin, and minerals. Chick pea (*Cicer arietinum*) is a very important pulse crop in the leguminous family. This light brown coloured pulse is considered to be a good source of protein and is also called by the name of "Garbanzo beans legumes are vital sources of protein, calcium, iron, phosphorus, and other minerals, they form a significant part of the diet of vegetarians since the other food items they consume do not contain much protein (Latham, M. C. 1997). Human nutrition in the developing world (No. 29). Rome: Food & Agriculture Organization of the United Nations.

Chickpea is the second most important pulse crop after pigeon pea in the word for human diet and other use. Since 1990, a rise in the productivity of chickpea in India has been observed from 614 kg per hectare to 735 kg per hectare. The yield of chickpea was highest in Andhra Pradesh (1615 kg. /ha), followed by Bihar (1000 kg./ha), West Bengal (1000 kg. /ha.) M.P. (926 kg.ha). U.P. (892 kg. /ha) and Gujrat (892 kg. /ha.). The yield of other states is below the country average (808 kg.ha.). In Chhattisgarh, chickpea is grown over an area of 366.10 thousand ha and average productivity of 1100 kg/ha (Anonymous, 2016-17).

Chickpea seed has carbohydrate (38-59%), fiber (3%), oil (4.8 to 5.5%), ash (3%), Calcium (0.2%) and phosphorus (0.3%). Digestibility of protein varies from 76-78 % and its carbohydrate from 57-60 % (Hulse, 1991, Huisman and van der poel, 1994). Micronutrient deficiency Zn and Fe is major problem of now days because of use of high yielding varieties, intensive cropping system, inadequate supply of micronutrient and loss of organic matter content by erosion and pollution. Iron involved in chlorophyll and thylakoid synthesis and development of chloroplast and important element for plant growth and development. Zn application influence on synthesis of auxine, nodulation and nitrogen fixation which enhance the plant growth and development of crop and ultimately influence the seeed yield (Kasthurikrishna and Ahlawat, 2000). Application of Zn enhance quality and yields of chickpea reported by Khan *et al*., 2003 [4].

Material and Methods

A field experiment was carried out at Instructional Cum Research Farm of IGKV, Raipur (Chhattisgarh), during Rabi season in 2016-17 and 2017-18. The experiment was conducted with two main plots of varieties viz., Vaibhav, Indira chana-1 and six sub-plot with treatment viz., T1: Recommended dose of NPK (Standard control), T2: RDF (20:50:20)+ 0.5% $ZnSO_4$ foliar application at flowering and pod formation stage, T3: RDF(20:50:20)+ 0.1% FeSO4 foliar application at pre flowering and pod formation stage, T4: RDF(20:50:20)+ 0.5% $ZnSO_4$ and 0.1% $FeSO_4$ through foliar application at pre flowering and pod formation stage, T5: RDF(20:50:20)+ Seed treatment 2g $ZnSO_4$/ kg of seed, T6: RDF(20:50:20)+ Soil application of $ZnSO_4$ @ 25 kg/ha at basal in sub plots. The data on seed yield, stover yield, harvest index, gross return, net return and B: C Ratio were recorded based on two years and on mean basis were tabulated and statistically analyzed.

Table 1: Yields of chickpea as influenced by bio-fortification through foliar supplementation of Zn and Fe (Pooled data mean of 02 years)

Treatment	Seed yield (kg/ha)			Stover yield (kg/ha)			Harvest index (%)		
Genotype	2016-17	2017-18	Mean	2016-17	2017-18	Mean	2016-17	2017-18	Mean
Vaibhav	1563.85	1616.10	1589.98	2642.65	2733.62	2688.14	37.17	37.10	37.14
Indira chana 1	1692.47	1742.74	1717.60	2744.03	2800.96	2772.50	38.16	38.30	38.23
CD (0.05%)	82.25	81.82	82.02	NS	56.74	57.58	0.66	NS	1.00
Nutrient levels									
Recommended dose of NPK (control)	1420.00	1450.27	1435.14	2651.83	2719.22	2685.53	34.87	34.78	34.83
RDF(20:50:20) + 0.5% $ZnSO_4$ foliar application	1680.65	1740.74	1710.69	2795.26	2779.50	2787.38	37.53	38.47	38.00
RDF(20:50:20) + 0.1% $FeSO_4$ foliar application	1621.38	1668.51	1644.94	2736.41	2764.49	2750.45	37.20	37.62	37.42
RDF(20:50:20)+ 0.5%$ZnSO_4$ and 0.1%$FeSO_4$ through foliar application	1743.84	1818.09	1780.96	2614.87	2814.46	2714.66	40.06	39.26	39.65
RDF(20:50:20)+ Seed treatment 2g $ZnSO_4$ /kg of seed	1599.11	1633.31	1616.21	2785.13	2731.98	2758.55	36.52	37.38	36.95
RDF(20:50:20)+ Soil application of $ZnSO_4$ @ 25 kg/ha basal (Recommended practice)	1703.98	1765.61	1734.79	2576.57	2794.12	2685.35	39.81	38.71	39.27
CD (0.05%)	84.08	86.05	84.95	NS	NS	NS	1.24	1.28	1.14

Table 2: Economics of chickpea as influenced by bio-fortification through foliar supplementation of Zn and Fe (Pooled data mean of 02 years)

Treatment	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)			Net return (Rs/ha)			B:C ratio		
Genotype	Mean	2016-17	2017-18	Mean	2016-17	2017-18	Mean	2016-17	2017-18	Mean
Vaibhav	20972	73015.90	74767.16	73891.53	52043.90	53795.16	52919.53	2.48	2.56	2.52
Indira chana 1	20972	78905.03	80523.11	79714.07	57933.03	59551.11	58742.07	2.76	2.84	2.80
CD (0.05%)		3785.80	3707.72	3746.18	3785.80	3707.72	3746.18	0.18	0.18	0.18
Nutrient levels										
Recommended dose of NPK (control)	20557	66551.83	67325.29	66938.57	45994.83	46768.29	46381.57	2.24	2.28	2.26
RDF + 0.5% $ZnSO_4$ foliar application	20822	78424.51	80423.54	79424.02	57602.51	59601.54	58602.02	2.77	2.86	2.81
RDF + 0.1% $FeSO_4$ foliar application	20887	75698.28	77138.95	76418.62	54811.28	56251.95	55531.62	2.62	2.69	2.66
RDF+ $ZnSO_4$ and $FeSO_4$ through foliar application	21152	81087.55	83889.06	82488.31	59935.55	62737.06	61336.31	2.83	2.97	2.90
RDF+ Seed treatment 2g $ZnSO_4$ /kg of seed	20607	74745.19	75544.15	75144.67	54138.19	54937.15	54537.67	2.63	2.67	2.65
RDF+ Soil application of $ZnSO_4$ @ 25 kg/ha (Recommended practice)	21807	79255.45	81549.80	80402.63	57448.45	59742.80	58595.63	2.63	2.74	2.69
CD (0.05%)		3898.37	3867.79	3876.47	3898.37	3867.79	3876.47	0.19	0.18	0.18

Results and Discussion

Seed and stover yields (kg/ha)

The data on seed yield, stover yield and harvest index of chickpea genotypes and different nutrient levels treatments during both the years and on mean basis was recorded and presented in Table 1.

Data indicated that chickpea genotype Indira chana-1was found significantly higher in seed yield, stover yield and harvest index over the variety Vaibhav during both the years and on mean basis except stover yield during year 2016-17 and harvest index during year 2017-18.

Seed yields of chickpea genotype were significantly influence under different nutrient levels treatments. It was recorded that treatment RDF(20:50:20)+ 0.5% $ZnSO_4$ and 0.1% $FeSO_4$ through foliar application at pre flowering and pod formation stage has maximum seed yield, stover yield and harvest index compared to other treatments which is par to treatment RDF(20:50:20)+ Soil application of $ZnSO_4$ @ 25 kg ha^{-1} at basal and RDF(20:50:20)+ 0.5% $ZnSO_4$ foliar application at pre flowering and pod formation stage during both the years and on mean basis and the minimum seed yield under treatment RDF(20:50:20) (Standard control). The stover yield was showing non-significant among all nutrient levels treatments during both the years and on mean basis. Highest harvest index was recorded with treatment RDF (20:50:20) + 0.5% $ZnSO_4$ and 0.1% $FeSO_4$ through foliar application at pre flowering and pod formations stage which is at par to treatment RDF (20:50:20) + Soil application of $ZnSO_4$ @ 25 kg ha^{-1} at basal during both years and on mean basis and RDF (20:50:20)+ 0.5% $ZnSO_4$ foliar application at flowering and pod formation stage during 2017-18. This might be due to zinc application enhance protein and carbohydrates synthesis and their transportation to the site of seed formation. The application of iron sulphate play an important role in

synthesis of cholorophyll and plant growth regulator and also improves photosynthesis and assimilates transportation to sink and finally increases seed yields. Similar results were reported by Mali *et al*. (2003) [5]. The treatment RDF (20:50:20) + Soil application of ZnSO4@ 25 kg ha-1 at basal, RDF (20:50:20) + 0.5% ZnSO4 foliar application at pre flowering and pod formation stage and RDF (20:50:20)+0.5% FeSO4 foliar application at pre flowering and pod formation stage was at par with treatment RDF (20:50:20)+ZnSO4 and FeSO4 through foliar application at pre flowering and pod formation stage. Similar results observed by Anitha *et al*. (2005) [1].

Economics

The Chickpea genotypes and all nutrient levels treatments wise economic returns were worked out by calculating operating cast of individual treatment. The data on gross returns, cost of cultivation, net return and B:C ratio of chickpea genotypes and different nutrient levels treatments during both the years and on mean basis was recorded and presented in Table.2.

Among chickpea genotypes Indira chana-1was found significantly higher in gross return and net return and B: C ratio over the variety Vaibhav during both the years and on mean basis.

As regards to different nutrient levels treatments combination of Zn and Fe, the significant variation was found in all treatments. The maximum gross return, net return and B:C ratio was recorded under treatment RDF(20:50:20)+ 0.5% $ZnSO_4$ and 0.1% $FeSO_4$ through foliar application at pre flowering and pod formation stage compared to other treatments However it was at par to treatment RDF(20:50:20)+ Soil application of $ZnSO_4$ @ 25 kg ha^{-1} at basal and treatment RDF(20:50:20)+ 0.5% $ZnSO_4$ foliar application at pre flowering and pod formation stage during both the years and on mean basis and minimum under treatment RDF(20:50:20) (Standard control).

Among the various zinc and iron fortification treatments, the treatment T4 treatment (RDF + Zn (0.5%) and Fe (0.05%) foliar spray) registered highest net returns (40960 ₹/ha) and gross returns (57833 ₹/ha) which was followed by treatment T7 (RDF+ seed treatment + Soil application of $ZnSO_4$ @ 25Kg/ha and T6 (RDF + soil application of $ZnSO_4$ @ 25 kg/ha). However, application of T4 treatment (RDF + Zn (0.5%) and Fe (0.05%) foliar spray) registered its, superiority in obtaining highest B: C ratio (2.42) which was followed by treatment T7 i.e. RDF+ seed treatment + Soil application of $ZnSo_4$ @ 25 kg/ha) (1.93). Whereas, the lowest benefit: cost ratio 1.15 was recorded with the treatment T1 (Recommended dose of NPK (control) (Kapilashiv Bazgalia and Brij Nandan *et al* 2017).

Conclusion

On the basis of two years data and on mean basis it concluded that the chickpea genotype Indira chana-1 give higher seed yield, stover yield, harvest index, gross return and net return than genotype Vaibhav. Nutrient levels treatments application of RDF (20:50:20) +0.5% $ZnSO_4$ and 0.1% $FeSO_4$ through foliar application at pre flowering and pod formation stage has beneficial influence on seed yield, gross return and net return.

References

1. Anitha S, Sreenivasan E, Purushothaman SM. Response of cowpea (*Vigna unguiculata* L.) to foliar nutrition of zinc and iron in the oxisols of Kerala. Legume Research. 2005; 28(4):294-296.
2. Anonymous. Krishi Darshika, I.G.K.V., Raipur, (C.G.), 2016-17b.
3. Jat BL, Gupta JK, Meena RL, Sharma RN, Bhati DS. Effect of foliar application of zinc sulphate and thiourea on productivity and economics of chickpea (*Cicer arietinum*). Journal of Progressive Agriculture. 2014; 5(2):62-65.
4. Khan HR, Mc Donald GK, Rengel Z. Zn fertilization improves water use efficiency, *grain* yield and seed Zn content in chickpea. Plant and Soil. 2003; 249:389-400.
5. Mali GS, Sharma NN, Acharya HK, Gupta SK, Gupta PK. Response of pigeon pea to S and Zn fertilization on vertisols in south- eastern plain of Rajasthan. Advances in Arid Legumes Research, 2003, 267-271.
6. Nandan B, Sharma BC, Chand G, Bazgalia K, Kumar R, Banotra M. Agronomic fortification of Zn and Fe in chickpea an emerging tool for nutritional security – A Global Perspective. Acta Scientific Nutritional Health. 2018; 2:12-19.
7. Shakya MS, Patel MM, Singh VB. Knowledge level of chickpea growers about chickpea production technology. Indian Research Journal of Extention Education. 2008; 8:65-68.
8. Singh U, Kumar N, Praharaj CS, Singh SS, Kumar L. Ferti-Fortification: an easy Approach for Nutritional Enrichment of Chickpea. An International Quarterly Journal of 2015.
9. Sheftela AD *et al*. The long history of iron in the universe and in health and disease. Biochimica et Biophysica Acta (BBA) - General Subjects. 2011; 1820(3):161-187.
10. Best C *et al*. Can multi micronutrient food fortification improve the micronutrient status, growth, health, and cognition of schoolchildren? A systematic review. Nutrition Reviews. 2011; 69(4):186-204.
11. Tripathi S *et al*. Genetic Variability and Inter-relationships of Phenological, Physicochemical and Cooking Quality Traits in Chickpea. ICRISAT, Patancheru, Hyderabad, 2012.
12. Shamsi K. Effect of Sowing Date and Row Spacing on Yield and Yield Components of Chickpea under Rain fed Conditions in Iran. Islamic Azad University, Kermanshah Branch, Iran. Journal of Applied Biosciences. 2009; 17:941-947.
13. Valenciano JB *et al*. Response of chickpea (*Cicer Arietinum* L.) yield to Zinc, Boron and Molybdenum application under pot conditions. Spanish Journal of Agricultural Research. 2010; 8(3):797-807.
14. Pathak GC *et al*. Improving reproductive efficiency of chickpea by foliar application of zinc. Brazilian Journal of Plant Physiology. 2012; 24(3):173-180.
15. Pandey N *et al*. Foliar application of Zn at flowering stage improves plant's performance, yield and yield attributes of black gram. Indian Journal of Experimental Biology. 2013; 51:548-555.
16. Shivay YS *et al*. Genetic Variability for zinc use efficiency in chickpea as influenced by zinc fertilization. International Journal of Bio-resource and stress management. 2014a; 5(1):031-036.
17. Parimala K *et al*. Effect of Nutrient Sprays on Yield and Seedling Quality Parameters of Chickpea (*Cicer arietinum* L.). Plant Archives. 2013; 13(2):735-737.
18. Dadkhah N *et al*. The effects of zice fertilizer on some physiological characteristics of chickpea (*Cicerarietinum*

L.) under water stress. Iranian Journal of Pulses Research. 2015; 6(2):59-72.
19. Balai K, Sharma Y, Jajoria M, Deewan P, Verma R. Effect of Phosphorus, and Zinc on Growth, Yield and Economics of Chickpea (*Cicer arietinum* L.). International Journal of Current Microbiology and Applied Sciences. 2017; 6(3):1174-1181.
20. Ferrandon M, Chamel AR. Cuticular retention, foliar absorption and translocation of iron, manganese and zinc supplied in organic and inorganic form. Journal of Plant Nutrition. 1988; 11:247-64.
21. Gizawy N, Mehasen SAS. Yield and seed quality responses of chickpea to inoculation with phosphorein, phosphourus fertilizer and spraying with iron. The 4th Scientific Conference of Agricultural Sciences, Assiut, 2004.
22. Gupta SC, Gangawar Suchi, Dubey M. Effect of micronutrients and bio-fertilizers on growth, yield attributing characters, yield and economics of chickpea (*Cicer arietinum* L.). Journal of Soils and Crops. 2012; 22(2):287-291.
23. Habbbasha SF, Mohamed MH, Abd El-LAteef EM, Mekki BB, Ibrahim ME. Effect of combined Zinc and Nitrogen on Yield, chemical constituents and Nitrogen Use efficiency of some chickpea cultivars under sandy soil conditions. World Journal of Agricultural Sciences. 2013; 9(4):354-360.
24. Hadi MRHS, Bazargani P, Darzi MT. Effects of Irrigation treatments and Zinc foilar Application on yield and yield components of Chickpea (*Cicer arietinum*). International Journal of Farming and Allied Sciences. 2013; 2(19):720-724.
25. Hidoto L, Worku W, Mohammed H, Taran B. Effects of zinc application strategy on zinc content and productivity of chickpea grown under zinc deficient soils. Journal of Soil Science and Plant Nutrition. 2017; 17(1):112-126.
26. Hotz C, Brown KH. Assessment of the risk of Zn deficiency in population and options for its control. Food and Nutition Bulletin. 2004; 25:S91-S204.
27. Janmohammadi M, Javanmard A. Influences of micro-nutrients (zinc and iron) andbio-fertilizer on yield and yield components of chickpea (*Cicer arietinum* L.) cultivars. Agriculture & Forestry. 2012; 57(11):53-66.