The Journal of Rural and Agricultural Research Vol. 18 No. 2, 26-28 (2018)
Received August 2018; Acceptance December 2018

Effect of phosphorus and zinc application on yield, uptake of Zn and quality of chickpea (*cicer arietinum* l.)

J.K. TIWARI AND JAGANNATH PATHAK
Department of Soil Science & agricultural Chemistry, College of Agriculture, Banda University of Agriculture & Technology, Banda (UP) -210001.
Email: *jtiwarikishor@gmail.com*

Abstract

A field experiment was conducted by KVK Rajnandgaon (CG) on irrigated chickpea during rabi season of 2014-15. Four levels of phosphorus i.e. 0, 20, 40 and 60 kg P/ha and three levels of zinc i.e. 0, 5 and 10 kg Zn/ha were applied through SSP and $ZnSO_4$, respectively. Experiment was laid out in factorial R.B.D. with three replications and 12 treatment combinations. Seed yield of chickpea was increased in the linear fashion with increasing levels of P and Zn up to 60 kg P and 10 kg Zn/ha. The combined application of 60 kg P + 10 kg Zn/ha produced highest yield 24.29 q/ha. Protein content improved with increasing levels of P and Zinc. Application of 60 kg P and 10 kg Zn/ha recorded highest value of 22.63 per cent seed protein. The combined use of 60 kg P and 10 kg Zn/ha in chickpea showed maximum value of Zn uptake 161.03 g/ha.

Key Words: Chickpea, Seed Yield, Protein Content, Zinc and Phosphorus, Uptake

Introduction

India is the largest pulse producing country in the world with 25 % share in global production from 32 percent area (Ali and Kumar, 2008). Rajnandgaon district is situated in southern part of Chhattishgarh and lies between 19.57^0 N to 21.42^0 N latitude and 80.23^0E to 81.31^0E longitude. Chickpea is the major rabi crop of Chhattishgarh and district Rajnandgaon cover the area of 56370 ha under chickpea cultivation with average productivity 10.67 q / ha. Removal of micronutrients under intensive cropping systems and heavy use of nitrogenous, phosphatic and potassic fertilizers have resulted in micronutrient deficiency, in general and zinc deficiency in particular (Gangwar and Singh, 1994). Higher application of phosphorus in soil, may cause zinc deficiency**.** Thus in pulse crops where P-fertilization is a usual practice, application of zinc in proper amount is necessary for getting good crop yields. Therefore, it becomes necessary to find out the crop response to graded levels of zinc application with increasing levels of phosphorus in chickpea crop.

Materials and Methods

The chickpea variety JG-16 was grown under field experiment conducted by Krishi Vigyan Kendra Rajnandgaon(CG). Twelve treatments combinations comprised of 4 phosphorus levels (0, 20, 40 and 60 kg P/ha) applied through single super phosphate and 3 zinc levels (0, 5 and 10 kg Zn/ha) applied through zinc sulphate. Experiment was laid out in factorial *R.B.D* with 3 replications. The experimental soil was clay loam in texture and had pH (1:2.5) 6.8, EC 0.25 dSm^{-1}, organic carbon 4.7 g kg^{-1}, DTPA extractable Zn 0.34 mg kg^{-1}, available N 211 kg ha^{-1}, available P 8.68 kg ha^{-1} and available K 190 kg ha^{-1}. Entire dose of P & Zn was applied as basal at the time of sowing. Uniformly applied @ 25 kg/ha N and K through urea and MOP in all treatments.

Seed quality was determined in term of protein content in seed. It was worked out on the basis of nitrogen content in seed samples in all treatments. Nitrogen content of each treatment was multiplied with the constant factor 6.25 and obtained value was recorded as protein per cent in seed (A.O.A.C., 1965).

Results and discussion

Seed yield per hectare increased linearly with increasing levels of P and Zn. The dose of 20, 40 and 60 kg P/ha produced 17.96, 20.18 and 22.27 q/ha seed yield, respectively against 15.29 q/ha without P application. The levels of 0, 5 and 10 kg Zn/ha recorded

17.23, 19.15 and 20.40 q/ha seed yield, respectively. Increase in seed yield due to increased P application has also been reported by Singh and Yadav (1985) up to 60 kg P/ha, Parihar (1990) up to 75 kg P/ha, Dadhich and Mali (1991) up to 60 kg P/ha, Bahadur *et al.* (2002) up to 80 kg P/ha, Ali *et al.* (2004) up to 90 kg/ha and Mansur *et al.* (2006) up to 75 kg P/ha. Application of zinc at increasing levels increased seed yields linearly up to 10 kg Zn /ha. Almost similar findings have also been reported by Sharma and Abrol (2007) and Valenciano *et al.* (2009).

Table 1: Yield of chickpea (q/ha) as influenced by increasing levels of phosphorus and zinc

Zinc levels (kg/ha)	Phosphorus levels (kg/ha) 0	20	40	60	Mean
	Seed yield (q/ha)				
0	14.00	16.50	18.32	20.08	17.23
5	15.45	18.13	20.56	22.44	19.15
10	16.42	19.24	21.67	24.29	20.40
Mean	15.29	17.96	20.18	22.27	-
Factor	P	Zn	P x Zn	-	-
S.Em. (±)	0.57	0.49	0.99	-	-
C.D. (P=0.05)	1.18	1.02	NS	-	-

Zinc content in seed recorded highest of 39.02 without P application which reduced to 37.96 ppm at 20 kg P, 36.90 ppm at 40 kg P and 35.88 ppm at 60 kg P/ha, respectively. Zn- content due to zinc fertilization was highest 41.49 ppm at 10 kg Zn/ha against lowest of 33.51 ppm without Zn application in seed, respectively. Total zinc uptake was also maximized at 60 kg P/ha with 134.75 g/ha against minimum without P application having 103.82 g/ha Zn-uptake. Application of 0, 5 and 10 kg Zn/ha recorded 96.79, 121.93 and142.60 g/ha Zn uptake, respectively. Zinc content in seed of chickpea reduced with increasing P levels up to 60 kg/ha, while zinc application increased Zn-content in seed up to 10 kg Zn/ha (Table 02). Decrease in Zn- content in seed with increased application of phosphorus might be due to antagonistic effect of P and Zn. It has also been reported by Singh *et al.* (2004) in case of wheat crop and, Sharma and Abrol (2007) in case of chickpea crop who reported that application of P decreased the concentration of Zn in grain of chickpea.

Protein content in seed was recorded 19.21, 20.15, 21.15 and 22.15 % at 0, 20, 40 and 60 kg P/ha, respectively. Application of 10 kg Zn/ha recorded maximum protein in seed (21.14 %) followed by 5 kg Zn/ha (20.12 %) and without Zn (19.92 %).The treatment combination of 60 kg P + 10 Zn/ha recorded highest values of 24.29 q/ha seed yield and 22.63 % seed protein. These results confirm the findings of Subhash Chand and Tripathi (2005), Kharche *et al.* (2006), Mansur *et al.* (2009) in case of phosphorus applications, and Kaya *et al.* (2009) in case of increasing zinc application.

Table 2: Zinc uptake (g/ha) in chickpea as influenced by increasing levels of phosphorus and zinc

Zinc levels (kg/ha)	Phosphorus levels (kg/ha) 0	20	40	60	Mean
	Zn- uptake in seed (g/ha)				
0	48.65	55.94	60.68	64.82	57.52
5	60.07	68.62	75.66	80.25	71.15
10	71.33	81.06	88.37	96.19	84.24
Mean	60.02	68.54	74.90	80.42	-
Factor	P	Zn	P x Zn	-	-
S.Em. (±)	1.49	1.29	2.58	-	-
C.D. (P=0.05)	30.09	2.68	NS	-	-
	Total Zn-uptake in-seed+straw (g/ha)				
0	84.42	94.13	101.14	107.45	96.79
5	104.89	118.12	128.94	135.78	121.93
10	122.15	138.10	149.13	161.03	142.60
Mean	103.82	116.78	126.40	134.75	-
Factor	P	Zn	P x Zn	-	-
S.Em (±)	3.36	2.89	5.78	-	-
C.D. (P=0.05)	6.92	5.99	NS	-	-

Table 3: Seed protein of chickpea as influenced by increasing levels of phosphorus and zinc

Zinc levels (kg/ha)	Phosphorus levels (kg/ha) 0	20	40	60	Mean
	Protein content (%) in seed				
0	18.25	19.38	20.50	21.56	19.92
5	19.94	20.25	21.25	22.25	20.92
10	19.44	20.81	21.69	22.63	21.14
Mean	19.21	20.15	21.15	22.15	-
Factor	P	Zn	P x Zn	-	-
S.Ed. (±)	0.02	0.02	0.03	-	-
C.D. (P=0.05)	0.04	0.03	0.07		

It is evident from Table 04 that, soil quality parameters like EC were not affected by treatments, whereas pH slightly reduced with application of phosphorus or zinc. Organic carbon and available nitrogen both increased with increasing levels of P and Zn, where maximum values were recorded at 60 kg P or 10 kg Zn/ha. Available P reduced without P application from its initial value, but increased with

Table 4: Soil quality status of experimental soil after crop harvest

Treatments	pH (1 : 2.5)	EC (dSm^{-1})	O.C. ($g\ kg^{-1}$)	Av. N (kg/ha)	Av. P (kg/ha)	Av. K (kg/ha)	DTPA-Zn ($mg\ kg^{-1}$)
Phosphorus levels (kg/ha)							
0	6.8	0.25	4.7	213	8.63	192	0.43
20	6.7	0.25	4.8	219	8.85	197	0.41
40	6.7	0.25	4.8	221	8.90	199	0.40
60	6.6	0.25	4.9	224	9.03	201	0.40
Zinc levels (kg/ha)							
0	6.7	0.25	4.8	219	8.90	195	0.32
5	6.7	0.25	4.8	219	8.84	197	0.40
10	6.6	0.25	4.9	221	8.81	199	0.51
Initial value	6.8	0.25	4.7	211	8.68	190	0.34

increasing application of P levels. Zinc application reduced the available P with increasing Zn levels, but remained higher than initial value in each case. Available K in soil increased from initial value in all cases and showed increase with increasing levels of both P and Zn. DTPA- Zn marginally declined fresh initial value without Zn fertilization, but increased with increasing Zn levels remarkably. Increasing levels of P reduced Zn status of soil, even than values were found higher compared to its initial value in experimental soil.

References

Ali, H., Khan, M.A. and Randhawa, S.A. (2004). Growth and yield potential of chickpea as influenced by seed inoculation and phosphorus application. *Indian Journal of Plant Sciences.* 3 (2) : 208-213.

Ali, M. and Kumar, S. (2008). Pulses : wide array of improved varieties. *The Hindu Survey of Indian Agriculture,* Kasturi and sons Ltd. Channai- 600002. pp 43-46.

Bahadur, M.M., Ashraf Ujjaman, M., Kabir, M.A. Chowdhury, M.F. and Majumdar, DAN (2002). Response of chickpea (*Cicer arietinum* L.) varieties to different levels of phosphorus . Crop Research Hisar 23 (2) : 293-299.

Dadhich, S.C. and Mali, A.L. (1991). Effect of herbicide and phosphorus on crop weed competition in chickpea (*Cicer arietinum). Indian Journal of Agronomy* 36 (Suppl) : 283-285.

Gangwar, K.S. and Singh, N.P. (1994). Studies on zinc nutrition on lentil in relation to dry matter accumulation, yield and N, P uptake. *Indian Journal of Pulses Research* 7 (1) : 33-35.

Kaya, M., Kucukyumuk, Z. and Erdal, I. (2009). Phytase activity, phytic acid, zinc, phosphorus and protein contents in different chickpea genotypes in relation to nitrogen and zinc fertilization. *African Journal of Biotechnology* 8 (18) : 4508-4513.

Kharche, P.V. Kubde, K.J. and Solunke, P.S. (2006). Effect of phosphorus, sulphur and PSB on quality components and nutrient uptake in chickpea. *Annals of plant physiology* 20 (1) : 78-81

Mansur, C.P., Palled, Y.B., Solimath, P.M., Chetti, M.B. and Halikatti, S.I. (2006). Productivity of kabuli chickpea genotypes as influenced by plant densities and phosphorus rates. Karnataka Journal of Agricultural Sciences 19 (3) : 498-501.

Mansur, C.P., Palled, Y.B.; Halikatti, S.I., Salimath, P.M. and Chetti, M.B. (2009). Effect of plant densities and phosphorus levels on seed yield and protein content of kabuli chickpea genotypes. *Karnataka Journal of Agricultural Sciences* 22 (2) : 267-270.

Parihar, S.S. 1990. Yield and water use of chickpea (*Cicer arietinum*) as influenced by irrigation and phosphorus. *Indian Journal of Agronomy* 35 (3) : 251-257.

Singh, S.C. and Yadav, D.S. (1985). Response of chickpea (*Cicer arietinum* L.) varieties to phosphorus levels and seeding rates. *Indian Journal of Agronomy* 30 (4) : 414-416.

Subhash Chand and Tripathi, A.K. (2005). Effect of phosphorus fertilization of yield quality, nutrient uptake and energetics of chickpea + Indian mustard intercropping systems. *Haryana Journal of Agronomy* 21 (2) :164-168.

Valenciano, J.B., Miguelez-Frade, M.M. and Marcelo, V. (2009). Response of chickpea (*Cicer arietinum* L.) to soil zinc application. *Spanish Journal of Agricultural Research* 7 (4) : 952-956.