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The Yield, Nutrients Uptake and Quality parameters of Chickpea as Affected by Phosphorus and Zinc Application

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Abstract

A field experiment was conducted during 2020-21 and 2021-22 at Student Instumental Farm of C. S. Azad University of Agriculture and Technology, Kanpur with RGV-203 variety of chickpea was taken as test crop. The maximum pod/plant 61.26 and 60.89, grain/pod 1.73 and 1.71, test weight 20.20 gram and 19.82 gram, grain yield 18.85 q ha^{-1} and 18.24 q ha^{-1}, straw yield 23.25 q ha^{-1} and 22.96 q ha^{-1}, biological yield 42.20 q ha^{-1} and 41.20 q ha^{-1}, harvest index 44.67 % and 44.27 % and protein concentration in grain (20.9 %) and (20.87 %) was recorded with the combined application of P (60 kg ha^{-1})+ Zn (9 kg ha^{-1}) and P (40 kg ha^{-1}) + Zn (6 kg ha^{-1}) respectively. The highest uptake of nitrogen was recorded under P (60 kg ha^{-1})+ Zn (9 kg ha^{-1}) over control treatment by grain and stover of chickpea were 63.15 and 33.16 kg ha^{-1}, respectively. The uptake of phosphorus in grain and stover increased with P (60 kg ha^{-1})+ Zn (9 kg ha^{-1}) to the tune of 51.8 and 47.1 % respectively over P_0 and Zn_0 level. The maximum uptake of K by the crop was recorded with the application of P (60 kg ha^{-1})+ Zn (9 kg ha^{-1}) and minimum in control treatment. The highest uptake of zinc by grain 49.91 kg ha^{-1} and straw 52.67 kg ha^{-1} was recorded with the combined application of P (60 kg ha^{-1})+ Zn (9 kg ha^{-1} treatment.

Keywords : Phosphorus, Zinc, Chickpea, Yield, Nutrient uptake, Quality parameters.

Introduction

Phosphorus is essential for energy on version and metabolic processes. It is known to be associated with nitrogen fixation. It promotes root development. Phosphorus by promoting more extensive and deeper root growth enables the crop to grow the water from deeper layers, which may be out of reach unfertile crop due to its shallower root system. Zinc is require for the proper functioning of various metabolic processes it is necessary for chlorophyll carbohydrate production. Several enzyme system, auxin and protein synthesis, seed formation and maturity rate all require zinc, either directly or indirectly. Zinc is known to help with RNA synthesis, which is required for protein production. In the plant zinc is not-trans located. As a result, symptom occur first on the plant younger leafs and other sections. It is therefore, the present study was undertaken to the effect of phosphorus and zinc levels on yield, nutrients uptake and quality parameters of chickpea.

Materials methods

A field experiment was conducted during 2020-21 and 2021-22 at SIF Farm of C. S. Azad University of Agriculture and Technology, Kanpur. It is located on

25^0 18 N' latitude, 83^0 03 E' longitude and 80.71 meters above mean sea level. The total rainfall received during the crop growing period was 15.90 mm. The experimental soil had pH 8.2, EC 0.63 dSm^{-1}, organic carbon 0.34 %, available N 195, P 12.5 , K 142.6, S 0.46 kg ha^{-1} and zinc 11.57 mg kg^{-1}. The experiment was carried out in the factorial randomized block design with sixteen treatments replicated three times. The treatments were each four levels of Phosphorus (0, 20, 40 and 60 kg ha^{-1}) and zinc (0, 3, 6 and 9 kg ha^{-}1). The RGV-203 variety of chickpea was taken as test crop. The full dose of nitrogen and potash were applied at the time of sowing. Phosphorus and zinc were applied as per treatments. The N, P, K and zinc were applied through urea, SSP, muraite of potash and zinc sulphate respectively. The uniform irrigation was applied at pre flowering and pod filling stages. The agronomical practices were applied as per requirement of the crop. The data of yield and growth parameters was recorded at the time of crop maturity. The soil samples were analyzed for EC, pH and organic carbon analyzed with standard procedure. The available N was determined by alkaline per magnate method as described by [5]. The available P was extracted with 0.5 ml NaHCO3 [3]. The available K was determined by flame photometer. The available S determined by Turbidimetric method described by [1].and available Zn was determined by DTPA extraction.

Results and discussion

Yield and yield attributes

The yield and yield attributing characters of chickpea were significantly influenced with the application of different treatments (Table-1). The pod/plant ranged from 45.00 to 61.26 with the mean value of 54.99, grain/pod 120 to 173 with the mean value of 1.49, test weight 16.96 to 20.20 gram with the mean value of 18.14 gram, grain yield 12.25 to 18.85 q ha^{-1} with the mean value of 15.44q ha^{-1},stover yield 17.16 to 23.25 q ha^{-1} with the mean value of 20.23 q ha^{-1}, biological yield 29.41 to 42.29 q ha^{-1} with the mean value of35.69 q ha^{-1} and harvest index from 41.65 to 44.67 percent with the mean value of 43.14 percent with the application of differentphosphorus and zinc levels. The maximum pod/plant 61.26 and 60.89, grain/pod 1.73 and 1.71, test weight 20.20 gram and 19.82 gram, grain yield 18.85 q ha^{-1} and 18.24 q ha^{-1}, straw yield 23.25 q ha^{-1} and 22.96 q ha^{-1}, biological yield 42.20 q ha^{-1} and 41.20 q ha^{-1} and harvest index 44.67 % and 44.27 % was recorded with the combined application of P (60 kg ha^{-1})+ Zn (9 kg ha^{-1}) and P (40 kg ha^{-1}) and Zn (6 kg ha^{-1}). Respectively due to maximum nodulation and development of roots of chickpea and minimum in P (0 kg ha^{-1}) + Zn (0 kg ha^{-1}) control plot. The yield and growth parameters increased with the combined use of phosphorus and zinc were found non-significant because P and Zn are antagonistic to each other. The similar results were reported by Yadav *et al.* (2022). The pod/plant (26.5 %) and (26.1) %), grain/pod (30.6 %) and (29.8 %), test weight (16.0 %) and (14.4 %), grain yield (35.0 %) and (32.8 %), straw yield (26.2 %) and (25.3 %), biological yield (30.3 %) and (28.6 %) and harvest index (6.76 %) and (5.92 %) with the combined application of P (60 kg ha^{-1})+ Zn (9 kg ha^{-1}) and P (40 kg ha^{-1}) + Zn (6 kg ha^{-1}) respectively over P (0) + Zn (0)control plot.The results are in accordance with [7].The not remarkable responses with the application of other treatments.

Quality parameters

The protein concentration in grain of chickpea were significantly influenced with the application of different treatments (Table-1). The protein concentration in grain ranged from 19.56 to 20.68 % with the mean value of 20.28 % with the application of different phosphorus and zinc levels. The maximum protein concentration in grain (20.9 %) and (20.87 %) was recorded with the combined application of P (60 kg ha^{-1})+ Zn (9 kg ha^{-1}) and P (40 kg ha^{-1}) + Zn (6 kg ha^{-1}) respectively. The minimumprotein concentration in grain was recorded with P (0) + Zn (0) control treatment. The results are in accordance with [6]. The highest protein concentration in grain (6.54 %) was recorded with the combined application of P (60 kg ha^{-1})+ Zn (9 kg ha^{-1}) over P (0) + Zn (0)control plot.

Table 1 Effect of phosphorus and zinc levels on yield and yield attributing characters of chickpea (mean of two years)

Treatments	Pod/plant	Grain/pod	Test weight (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Biological yield (q ha^{-1})	H.I. (%)	Protein concentration in grain (%)
T_1	45.00	1.20	16.96	12.25	17.16	29.41	41.65	19.56
T_2	47.21	1.27	17.42	12.52	17.35	29.8/7	41.91	19.68
T_3	52.21	1.36	17.65	13.76	18.72	32.48	42.36	19.94
T_4	48.43	1.31	17.53	12.87	17.81	30.68	41.95	19.81
T_5	50.12	1.32	17.61	13.24	18.25	31.49	42.05	19.87
T_6	54.21	1.48	17.71	14.86	19.65	34.51	43.05	20.18
T_7	55.18	1.49	17.87	15.34	20.12	35.46	43.26	20.25
T_8	53.42	1.43	17.68	14.25	19.10	33.35	42.73	20.06
T_9	56.21	1.52	17.94	15.77	20.46	36.23	43.53	20.37
T_{10}	59.87	1.62	18.12	16.96	21.78	38.74	43.78	20.62
T_{11}	60.89	1.71	19.82	18.24	22.96	41.20	44.27	20.87
T_{12}	58.13	1.57	18.10	16.71	21.34	38.65	43.91	20.56
T_{13}	57.32	1.55	18.03	16.10	20.95	37.05	43.45	20.44
T_{14}	60.38	1.69	19.11	17.65	22.54	40.19	43.92	20.75
T_{15}	61.26	1.73	20.20	18.85	23.25	42.20	44.67	20.93
T_{16}	60.12	1.65	18.42	17.71	22.24	39.55	43.76	20.68
CD at 5%	2.17	0.97	1.64	1.52	1.58	2.11	2.42	1.68

Nutrients uptake

The uptake of nutrients by seed and stover of chickpea were significantly influenced with the application of different treatments (Table-2). The nutrients uptake of N, P, K and Zn varied from 38.34 to 63.15, 5.63 to 12.25, 6.49 to 13.25 and 24.79 to 49.91 kg ha^{-1} in grain and from 20.59 to 33.16, 3.77 to 7.47, 28.48 to 43.66 and 28.17 to 52.67 kg ha^{-1} in stover with the mean value of 50.18, 8.89, 9.57 and 36.57 kg ha^{-1} in grain and 25.65, 5.50, 35.63 and 39.95 kg ha^{-1} in stover of chickpea respectively with the application of different phosphorus and zinc levels. The maximum uptake of N, P, K and Zn with the application of P (60 kg ha^{-1})+ Zn (9 kg ha^{-1}) followed by P (40 kg ha^{-1}) + Zn (6 kg ha^{-1})and minimum incontrol plot. Application of different phosphorus and zinc levels increased the nitrogen uptake by grain and stover over control plot. The uptake of nitrogen was highest under P (60 kg ha^{-1})+ Zn (9 kg ha^{-1}) over control treatment by grain and stover of chickpea were 63.15 and 33.16 kg ha^{-1}, respectively. This increase may be attributed to increased nitrogen concentration and grain and stover yield. The uptake of phosphorus in grain and stover increased with P (60 kg ha^{-1})+ Zn (9 kg ha^{-1}) to the tune of 51.8 and 47.1 % respectively over P_0 and Zn_0 level. The beneficial role of phosphorus and zinc might have accrued from chlorophyll synthesis and stimulatory effect on most of physiological and metabolic processes. This might have helped the plants in increased absorption of nutrients from soil. The similar results were reported by Singh and Singh (2012). The maximum phosphorus uptake by grain 12.25 kg ha^{-1} and stover 7.47 kg ha^{-1} was recorded under combined application of P (60 kg ha^{-1})+ Zn (9 kg ha^{-1}). Increase in phosphorus content and yield of chickpea resulted in significant increase in phosphorus uptake by chickpea. The results are in accordance with [4]. The maximum uptake of K by the crop was recorded with the application of P (60 kg ha^{-1})+ Zn (9 kg ha^{-1}) treatment. The highest uptake of zinc by grain 49.91 kg ha^{-1} and straw 52.67 kg $ha^{-1}$was recorded with the combined application of P (60 kg ha^{-1})+ Zn (9 kg ha^{-1}) may be due to increase in zinc content and yield.

Table 2 Effect of phosphorus and zinc levels on nutrients uptake by chickpea kg ha^{-1} (mean of two years)

Treatments	Grain				Straw			
	N	**P**	**K**	**Zn**	**N**	**P**	**K**	**Zn**
T_1	38.34	5.63	6.49	24.79	20.59	3.77	28.48	28.17
T_2	39.44	6.01	6.76	26.10	20.99	3.99	28.97	28.88
T_3	43.89	7.30	7.70	29.92	23.59	4.68	32.01	33.49
T_4	40.80	6.31	7.08	27.18	21.90	4.09	29.92	30.18
T_5	42.10	6.75	7.41	28.41	22.63	4.38	30.84	31.66
T_6	48.00	8.32	8.47	33.80	25.74	5.11	34.19	37.04
T_7	49.70	8.89	8.90	35.75	26.56	4.43	35.21	39.07
T_8	45.74	7.69	8.12	31.66	24.63	4.97	33.04	34.95
T_9	51.41	9.30	9.35	37.62	27.41	5.73	35.80	40.67
T_{10}	55.96	10.34	11.14	42.57	30.27	6.53	38.98	46.52
T_{11}	60.92	11.67	12.76	47.60	32.37	7.12	42.47	50.78
T_{12}	54.97	10.19	11.25	41.25	29.45	6.19	37.98	44.68
T_{13}	52.64	9.66	10.26	38.83	28.49	5.86	37.08	42.75
T_{14}	58.59	11.12	12.32	45.67	31.55	6.98	41.25	49.56
T_{15}	63.15	12.25	13.25	49.91	33.16	7.47	43.66	52.67
T_{16}	57.29	10.73	11.87	44.10	31.14	6.67	40.25	48.19
CD at 5%	2.31	1.47	1.43	1.37	2.37	1.62	1.57	1.46

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