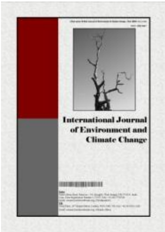

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Effect of Phosphorus and Zinc Levels on Growth and Yield Attributes in Varieties of Chickpea (*Cicer arietinum* L.) Prayagraj Condition

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted at the Crop Research Farm (CRF), Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (UP) during the year 2021 *rabi* season. The experiment comprised of 8 treatments with different combinations of phosphorus, zinc and varieties (Pusa-362, Rvg-202) replicated thrice in a Randomized Block Design. The main objective of the experiment was to evaluate the Effect of phosphorus and zinc on growth and yield attributes in varieties of chickpea (*Cicer arietinum* L.). The phosphorus levels include [40 and 50 kg/ha] where-as levels of zinc include (3 and 4 kg/ha) and varieties sown are pusa-362 and Rvg-202. From the present investigation the profitable production of chickpea can be secured by pusa-362 variety with application of phosphorus (50 kg/ha) and zinc (4 kg/ha).

Keywords: Phsophorus; zinc; chickpea varieties yield.

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1. INTRODUCTION

Chickpea is one of the most important pulse crops in world agriculture economy. It contains 22 to 24% protein, which is almost twice the protein in wheat and thrice that of rice [1]. It is an easily available source of protein in the rural areas of India, Pulses provide significant nutritional and health benefits, and are known to reduce several noncommunicable diseases such as colon cancer and cardiovascular diseases [2]. Its botanical name is *Cicer arietium* L. belonging to the family Fabaceae. It is an important cool season pulse crop and is also called as Bengal gram. In terms of pulse production, India contributes to about 25% the global production [3]. It is a rich source of highly digestible dietary protein (17-21 per cent), carbohydrate (61.5 per cent) and fat (4.5 per cent). It is also rich in Ca, Fe, niacin, vitamin-B and vitamin C.

Phosphorus (P) is an essential nutrient for plants. It stimulates root development, increases stalk strength, improves flower growth and grain production, increased nitrogen fixing ability of legumes, improved quality of crops, and enhances resistance to disease. Phosphorus was found to increase pulse crop production [4]. Phosphorus fertilizer also increased chickpea yields, [5]. Legumes usually require more P because of the high energy requirements associated with symbiotic nitrogen fixation. Leguminous plants also require much more P in the form of ATP or ADP due to symbiotic Nitrogen (N) fixation. It improves the general health of the plant, as well as its resistance to adverse climatological conditions. The formation of organic compounds and the proper execution of photosynthesis depend on phosphorus. A lack of phosphorus will cause foliage to brown and wrinkle, as well as a lack of flowering.

Zinc (Zn) is necessary for chlorophyll formation and for growth hormone production. Additionally, it is an essential plant nutrient for growth and development. Plants use Zn to synthesize proteins and nucleic acids as well as to utilize N and P. Plants also use it for water uptake and retention. Zinc nutrient is receiving significant attention due to findings that applying it to many legume species increases the yield, nodulation, and N fixation. About 49% of Indian soils are deficient in zinc, and zinc application has been shown to influence the growth of crops including chickpea [6]. Generally, chickpeas suffer from zinc deficiency, though the degree varies between varieties. A zinc deficiency reduces crop yield and delays crop maturity. Reduces water use and water efficiency [7] and also reduces nodulation and N fixation [8].

The objectives undertaken are to study the influence of phosphorus and zinc levels on growth and yield attributes in varieties of chcickpea (*Cicer arietinum* L.) and to evaluate economics of different treatment combinations.

2. MATERIALS AND METHODS

The current study was carried out in the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, during the *Rabi* season 2021-22, (U.P.). The experimental field coordinates are 25.4089833, 81.8530037 and it is located approximately 9 kilometers from Prayagraj city, near the Yamuna River, on the left side of the Prayagraj-Rewa Road. Prayagraj is located in the subtropical zone of Uttar Pradesh, with hot summers and pleasant winters. The area's average temperature is 23°C to 38°C, with temperatures seldom dropping below 3°C or 4°C. The relative humidity levels range from 26% to 78%. In this location, the average annual rainfall is 1050 mm. The soil chemistry analysis revealed a sandy loam texture with a pH of 7.2, low amounts of organic carbon (0.48 percent) and potassium (215.4 kg/ha), and a low quantity of accessible phosphorus (13.6 kg/ha). The soil was electrically conductive and had a conductivity of 0.26 dS/m. For each of the eight treatment combinations, three replications were employed. The therapy details and treatment combinations are shown in Tables 1 and 2, respectively. Phosphorus, zinc and varieties (rvg-202, Pusa-362) were maintained according to the treatment combinations were all successfully measured, and an economic analysis of each treatment was completed to determine the best treatment combination for chickpea cultivation. The statistics were calculated and analysed using the sunnam Hemanth kumar [7] statistical approach which is one way annova table used to compare more than two groups based on one factor with F probability of 0.005% developed by Ronald Fisher in 1918 [9].

3. RESULTS AND DISCUSSION

3.1 Growth Parameters at Harvest

Data presented in Table 1 indicates significant increases in all growth parameters in chickpea at harvest, including plant height, dry weight per plant, and root nodules per plant. Application of pusa-362 with phosphorus 50 kg/ha and zinc 4kg/ha significantly increased yields, and remained at par with rvg-202 with phosphorus 50 kg/ha and zinc 4kg/ha. Pusa-362 at 50 kg/ha and 4 kg/ha results showed that 26.03 g/plant increase in plant dry weight, a 57.5 cm increase in plant height, and nodules per plant is 11.8 at harvest. The primary function of phosphorus, an energy bond compound, is to transform energy essential to almost all metabolic processes, such as photosynthesis, respiration, cell elongation and division, amino acid synthesis for protein synthesis, and carbohydrate metabolism, which increase the dry weight, according to Saraf et al. [10]. It is an important nutrient that directly affects the nodulation of legumes and pulses. It is essential for cell division, development of root nodules and stimulation of nitrogen fixation [11]. Fresh weight & dry weight of nodules plant-1 were also improved significantly due to increased level of phosphorus [12]. Zinc plays a pivotal role in cellular growth, differentiation, and metabolism which results in vigorous growth of plants and extensive root system leading to increased growth parameters such as plant height, root nodules, and dry weight. Similar results were also reported by Karwasra and Kumar [13], Sharma and Abrol [14], and Kharol et al., [15].

3.2 Yield Attributes

Table 2 shows phosphorus and zinc levels in varieties of chickpea. The data revealed that Significantly higher number of pods/plant, Seeds per pod, Test weight, Grain yield and stover yield was observed with the pusa-362 with application of phosphorus (50 kg/ha) and zinc (4 kg/ha) which was significantly higher over rest of the treatments except Rvg-202 with application of phosphorus (50 kg/ha) and zinc (4 kg/ha) which are statistically on par. Application of phosphorus and zinc favoured better root growth leads development of sink size (No. of pods/plant) similar findings was observed by Parihar [16], Zinc plays a very important role in metabolism of the plant process by influencing the activity of growth enzymes as well as it involved in carbohydrate metabloism, maintenance of the integrity of cellular membranes, protein synthesis, and regulation of auxin synthesis and pollen formation Upadhyay and Anita Singh [17]. The increased phosphorus fertilizer rates and due to favourable climatic conditions helps in increase the photosynthetic activity during seed filling stage as well as the formation of starch and albumin leads to increase the seeds per pod, no. of pods per plant, test weight, grain weight and stover yield. Similar findings have been observed by Yadav et al., [18], Kumar and sharma et al. [19].

3.3 Harvest Index (%)

The data on Harvest index (%) as influenced by different phosphorus, zinc and varieties of chickpea is tabulated in Table 2. It is evident from this data the harvest index (%) (34.16). Treatment 1 (RVG-202+ 40 kg/ha Phosphorus + 3 kg/ha Zinc) was recorded significantly maximum harvest index (36.09) and minimum treatment 8 (PUSA-362+ 50 kg/ha Phosphorus + 4 kg/ha Zinc) There is no significant. Highest harvest index was observed due to improved cell activities, enhanced cell multiplication and enlargement and luxuriant growth and yield attributes of the crops probably due to more absorption and utilization of available nutrients leading to overall improvement of crop growth reflected to source-sink relationship, which in turn enhanced the yield attributes that ultimately more yield. It was reported by Togay et al. [20].

Table 1. Effect of phosphorus and zinc levels on growth parameters at harvest of chickpea

S.No	Treatments	Plant height (cm)	No. of Nodule/plant	Plant dry Weight (g/plant)
1	RVG-202 +40 kg/ha Phosphorus + 3 kg/ha Zinc.	52.6	8.2	25.50
2	RVG-202 +40 kg/ha Phosphorus + 4 kg/ha Zinc.	53.0	8.6	25.64
3	RVG-202 +50 kg/ha Phosphorus + 3 kg/ha Zinc	54.5	10.2	25.71
4	RVG-202 +50 kg/ha Phosphorus + 4 kg/ha Zinc	**56.7**	**11.6**	**25.95**
5	PUSA-362 +40 kg/ha Phosphorus + 3 kg/ha Zinc	52.7	8.2	25.56
6	PUSA-362 + 40 kg/ha Phosphorus + 4 kg/ha Zinc	53.2	8.8	25.70
7	PUSA-362 + 50 kg/ha Phosphorus + 3 kg/ha Zinc	55.2	10.8	25.79
8	PUSA-362 + 50 kg/ha Phosphorus + 4 kg/ha Zinc	57.5	11.8	26.03
	Ftest (P-0.05%)	S	S	S
	SEm(±)	0.31	0.24	0.02
	CD(P=0.05%)	0.95	0.75	0.08

Table 2. Effect of phosphorus and zinc levels on yield attributes of chickpea

S.No	Treatments	No. of pods/plant	No. of Seeds/pod	Test weight (gm)	Seed yield(t/ha)	Stover yield (t/ha)	Harvest index (%)	B:C ratito
1	RVG-202 +40 kg/ha Phosphorus + 3 kg/ha Zinc.	43.42	2.0	239.1	2.22	3.93	36.09	1.97
2	RVG-202 +40 kg/ha Phosphorus + 4 kg/ha Zinc.	44.57	2.1	239.9	2.32	4.20	35.56	2.03
3	RVG-202 +50kg/ha Phosphorus + 3 kg/ha Zinc	44.37	2.1	241.4	2.40	4.36	35.46	2.16
4	RVG-202 +50kg/ha Phosphorus + 4 kg/ha Zinc	**45.97**	**2.3**	**243.8**	**2.41**	**4.53**	**34.78**	**2.11**
5	PUSA-362 +40kg/ha Phosphorus + 3 kg/ha Zinc	44.50	2.1	239.2	2.23	4.10	35.28	2.05
6	PUSA-362 + 40 kg/ha Phosphorus + 4 kg/ha Zinc	45.23	2.1	240.9	2.33	4.25	35.44	2.11
7	PUSA-362 + 50kg/ha Phosphorus + 3 kg/ha Zinc	45.57	2.1	242.1	2.40	4.44	35.12	2.19
8	PUSA-362 + 50 kg/ha Phosphorus + 4 kg/ha Zinc	**46.37**	**2.4**	**244.6**	**2.42**	**4.66**	**34.16**	**2.23**
	Ftest (P-0.005%)	S	S	S	S	S	NS	-----
	SEm(±)	0.45	0.06	0.30	0.02	0.13	0.83	-----
	CD(P=0.005%)	1.38	0.20	0.92	0.09	0.40	------	-----

3.4 Benefit Cost Ratio

In Table 2 The data on benefit cost ratio as influenced by different phosphorus, zinc and varieties of chickpea is tabulated in Table 2. Benefit Cost ratio (2.23) was found to be highest in treatment-8 (PUSA-362 with application of 40 kg/ha Phosphorus and 3 kg/ha Zinc) and the minimum benefit cost ratio (1.97) was found to be in treatment-1 (RVG-202 with application of 40 kg/ha Phosphorus and 3 kg/ha Zinc] as compared to other treatments.

4. CONCLUSION

On the basis of results obtained in present investigation, it is concluded that the profitable production of chickpea can be secured by pusa-362 application of phosphorus 50 kg/ha and zinc 4 kg/ha at agroclimatic zone in prayagraj, Uttarpradesh state, INDIA. These practices may be passed on to the farmers for obtaining higher returns in the prayagraj, Uttarpradesh agro-climatic zone.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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