Effect of phosphorous and zinc on growth and yield attributes in varieties of chickpea(*Cicer arietinum* L.) Prayagraj condition.

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 phosphorous, 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 phosphorous and zinc on growth and yield attributes in varieties of chickpea (*~~c~~Cicer arietinum* L.). The phosphorous levels include ~~[~~40 and ~~,~~50 kg/ha,~~]W~~where~~-~~as levels of zinc include ~~(~~3 and ~~,~~4 kg/ha~~)~~; and varieties sown are pusa-362 and Rvg-202. From the present investigation,~~ it is that~~ the profitable production of chickpea can be secured by pusa-362 variety with application of phosphorous(50kg/ha) and zinc(4kg/ha).

Keywords: ***~~phsophorous~~phosphorus*, *zinc*, *~~and~~ chickpea varieties yield*.**

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 (Shukla et al., 2013). It is an easily available source of protein in the rural ~~heart~~ areasof India~~, that is, village~~. Pulses provide significant nutritional and health benefits, and are known to reduce several noncommunicable diseases such as colon cancer and cardiovascular diseases (Jukanti et al., 2012). 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 ~~about 25%~~ to about 25% of the global ~~pulses~~ production (Pooniya and Pithia, 2015). 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 vitaminC.

~~Application of~~ Phosphorous (P) is an essential nutrient for plants. It stimulates~~d~~ root development, increases~~d~~ stalk strength, improves~~d~~ flower growth and grain production, increases~~d~~ nitrogen fixing ability of legumes, improves~~d~~ quality of crops, and enhances~~d~~ resistance to disease. Phosphorus was found to increase pulse crop production. (Sharma et al 2014). Phosphorus fertilizer also increased chickpea yields, (Islam et al 2011). 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 phosphor~~o~~us 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 (Katyal et al., 2004). 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 (Khan et al., 2002) and also reduces nodulation and N fixation (Ahlawat et al., 2007).

The following objectives have been undertaken to study the "Effect of phosphorous and zinc on growth and yield attributes in varieties of Chickpea (*Cicer arietinum* L.)"

Comment [JA1]: The sentence is not clear. Where are the objectives????

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 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~~ At 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. Phosphorous, zinc and varieties (rvg-202, Pusa-362) were maintained according to the treatment combinations. Variety Pusa-362 applied with 50kg Phosphorous, 4kg Zinc (Treatment 8) recorded maximum plant height (57.5 cm), Dry weight (26.03 gm) and more Number of Nodules / plant (11.8), Maximum No. of Pods/plant (46.37), Seeds/pod (2.5), Test weight (244.6) and grain yield (2.42), stover yield (4.66 t/ha) 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.

Comment [JA2]: GPS coordinates????

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Comment [JA4]: Please describe briefly this statistical approach

Results and Discussion

Growth parameters at maturity

Plant height (cm)

Table 1 shows application of phosphorous and zinc on plant at harvest. The Data indicated that phosphor~~o~~us had significant impact on plant height at harvest during the crop growth period. At harvest, maximum plant height (57.5 cm) was recorded with application of pusa-362 with application of phosphor~~o~~us 50kg/ha and zinc 4kg/ha which was significantly superior over rest of the treatments and remained at par with application rvg-202 with application of phosphor~~o~~us 50kg/ha and zinc 4kg/ha. The significant increase in plant height was due to increasing levels of

Comment [JA5]: at harvest OR during the crop growth period????

Phosphorous fertilizer throughout the measurement period. The increase in plant height in response to application of P fertilizers. The results were in accordance with **A.K. Mathur et al. (2014).**

Number of Nodules per plant

Table 1showsat harvest, maximum No. of nodules/plant (11.8) was recorded with application of ~~of~~ pusa-362 with application of phosphor~~o~~us 50kg/ha and zinc 4kg/ha which was significantly superior over rest of the treatments and remained at par with application rvg-202 with application of phosphorous 50kg/ha and zinc 4kg/ha. phosphorus is essential for cell division, development of root nodules and stimulation of nitrogen fixation (Marschner, 1995) Fresh weight & dry weight of nodules plant-1 was also improved significantly due to increased level of phosphorus (Saeed et al., 2004).

Dry weight per plant (gm)

Table 1 shows chickpea varieties with application of phosphorous and zinc on dry weight per plant at harvest. The Data indicated that at harvest, maximum dry weight (26.03g/plant) was recorded with application of pusa-362 with application of phosphorous 50kg/ha and zinc 4kg/ha which was significantly superior over rest of the treatments and remained at par with application rvg-202 with application of phosphorous 50kg/ha and zinc 4kg/ha. The significant increase in dry weight might be due to adequate supply of phosphorus being an energy bond compound and its major role is transformation of energy essential for almost all metabolic processes viz., photosynthesis, respiration, cell elongation and cell division, activation of amino acids for synthesis of protein and carbohydrate metabolism. Stated by Saraf et al. (1997).

Yield attributes:-

No. of pods/plant

Observations regarding the response of different levels of phosphorous and zinc on yield attributes in varieties of chickpea are given in table 2 the results revealed that there was maximum from the data that among different treatments, the pusa-362 with application of phosphorous (50kg/ha) and zinc (4kg/ha) recorded highest number of pods/plant (46.37) was at par with treatment of Rvg-202 with application of phosphor~~o~~us(50 kg/ha) and zinc (4kg/ha). Application of Pho + Zn favoured better root growth and development of sink size (number of pods plant-1) and ultimately higher seed yield. Similar findings was observed by **Parihar, (1990).**

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Seeds per pod

Table 2 shows phosphorous and zinc in varieties of chickpea. The data revealed that various treatment of the more number of seeds per pod was shown with pusa-362 application of phosphorous 50kg/ha and zinc 4kg/ha which was superior over rest of the treatments followed by rvg-202 with application of phosphorous 50kg/ha and zinc 4kg/ha from this study, Zinc plays a very important role in the metabolism of the plant process by influencing the activity of growth enzymes as well as it is involved in carbohydrate metabolism, maintenance of the integrity of cellular membranes, protein synthesis, and regulation of auxin synthesis and pollen formation. The similar results were observed by **Upadhyay** and **Anita Singh (2016).**

Test weight (gm).

The data on test weight (gm) as influenced by phosphorous and zinc in chickpea varieties is tabulated in table 2. It is evident from this data the test weight was significantly influenced by phosphorous, zinc and varieties. The highest test weight of chickpea (244.6gms) was measured with application pusa-362 application of phosphorous 50kg/ha and zinc 4kg/ha which was superior over rest of the treatments followed by rvg-202 with application of phosphorous 50kg/ha and zinc 4kg/ha from this study, The Test weight increased with increased phosphorus fertilizer rates. Increasing in thousand seed weight might be due to favorable climatic condition during seed filling stage as well as the formation of starch and albumin. This result was agreed with the findings of **Yadav et al., (2014)**

Grain yield (t/ha)

The data on grain yield (t/ha) as influenced by different phosphorous, zinc and varieties of chickpea is tabulated in table 2. It is evident from this data the grain yield was significantly influenced by different phosphorous, zinc and varieties in chickpea. The highest grain yield (2.42 t/ha) was measured with pusa-362 application of phosphorous 50kg/ha and zinc 4kg/ha which was superior over rest of the treatments followed by rvg-202 with application of phosphorous 50kg/ha and zinc 4kg/ha Grain yield was increased due to application of higher doses of phosphorous, which increases the photosynthetic activity and might have increased vegetative growth and yield attributes also improved ultimately increased grain yield. Similar findings have been observed by **kumar and sharma *et al.***
(2005).

Stover yield (t/ha)

The data on stover yield (t/ha) as influenced by different phosphorous, zinc and varieties of chickpea is tabulated in table 2. It is evident from this data the grain yield was significantly influenced by different phosphorous, zinc and varieties in chickpea. The highest stover yield (4.66 t/ha) was measured with pusa-362 application of phosphorous 50kg/ha and zinc 4kg/ha which was superior over rest of the treatments followed by rvg-202 with application of phosphorous 50kg/ha and zinc 4kg/ha. **Hassan *et al.* (2010)** observed that Stover yield is dependent on vegetative growth as use of balanced and optimum use of fertilizer increased plant height, green leaves per hill, and dry matter production, which finally resulted in higher straw yield.

Harvest index (%).

The data on Harvest index(%) as influenced by different phosphorous, 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+ 40kg/ha Phosphorous + 3 kg/ha Zinc) was recorded significantly maximum harvest index (36.09) and minimum treatment 8 (PUSA-362+ 50kg/ha Phosphorous + 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 which was reported by**Togay *et al.* (2005).**

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1.Benefit Cost ratio.

In Table 2 The data on benefit cost ratio as influenced by different phosphorous, 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 40kg/ha Phosphorous and 3kg/ha Zinc) and the minimum benefit cost ratio (1.97) was found to be in treatment-1 (RVG-202 with application of 40kg/ha Phosphorous and 3kg/ha Zinc] as compared to other treatments.

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 phosphoreus 50kg/ha and zinc 4kg/ha…. These practices may be passed on to the farmers for obtaining higher returns in this agroclimatic zone.

Comment [JA7]: State the applicable area for your results

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Table 1: Effect of phosphorous and zinc 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 +40kg/ha Phosphorous + 3 kg/ha Zinc.	52.6	8.2	25.50
2	RVG-202 +40kg/ha Phosphorous + 4 kg/ha Zinc.	53.0	8.6	25.64
3	RVG-202 +50kg/ha Phosphorous + 3 kg/ha Zinc	54.5	10.2	25.71
4	RVG-202 +50kg/ha Phosphorous + 4 kg/ha Zinc	56.7	11.6	25.95
5	PUSA-362 +40kg/ha Phosphorous + 3 kg/ha Zinc	52.7	8.2	25.56
6	PUSA-362 + 40kg/ha Phosphorous + 4 kg/ha Zinc	53.2	8.8	25.70
7	PUSA-362 + 50kg/ha Phosphorous + 3 kg/ha Zinc	55.2	10.8	25.79
8	PUSA-362 + 50kg/ha Phosphorous + 4 kg/ha Zinc	57.5	11.8	26.03
	Ftest	S	S	S
	SEm(±)	0.31	0.24	0.02
	CD(P=0.05%)	0.95	0.75	0.08

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Table 2: Effect of phosphorous and zinc 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 +40kg/ha Phosphorous + 3 kg/ha Zinc.	43.42	2.0	239.1	2.22	3.93	36.09	1.97
2	RVG-202 +40kg/ha Phosphorous + 4 kg/ha Zinc.	44.57	2.1	239.9	2.32	4.20	35.56	2.03
3	RVG-202 +50kg/ha Phosphorous + 3 kg/ha Zinc	44.37	2.1	241.4	2.40	4.36	35.46	2.16
4	RVG-202 +50kg/ha Phosphorous + 4 kg/ha Zinc	45.97	2.3	243.8	2.41	4.53	34.78	2.11
5	PUSA-362 +40kg/ha Phosphorous + 3 kg/ha Zinc	44.50	2.1	239.2	2.23	4.10	35.28	2.05
6	PUSA-362 + 40kg/ha Phosphorous + 4 kg/ha Zinc	45.23	2.1	240.9	2.33	4.25	35.44	2.11
7	PUSA-362 + 50kg/ha Phosphorous + 3 kg/ha Zinc	45.57	2.1	242.1	2.40	4.44	35.12	2.19
8	PUSA-362 + 50kg/ha Phosphorous + 4 kg/ha Zinc	46.37	2.4	244.6	2.42	4.66	34.16	2.23
	Ftest	S	S	S	S	S	NS	-----
	SEm(±)	0.45	0.06	0.30	0.02	0.13	0.83	-----
	CD(P=0.05%)	1.38	0.20	0.92	0.09	0.40	------	-----

Comment [JA9]: Please provide the value of P so we can check if it is less or equal to 0.05%