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Response of phosphorus and zinc on growth parameters of chickpea in Khaila, Jalandhar

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Abstract

The research experiment was conducted under the title; “Response of phosphorus and zinc on growth parameters of Chickpea in khaila, Jalandhar Punjab” was carried out at the research studies farm, Department of Agriculture, Sant Baba Bhag Singh University, Khaila, Jalandhar during Rabi season 2023. The experiment was laid out in a Randomized Block Design with three replications and 9 treatments comprising of T₀-Control (RDF), T₁- Zinc (10 kg/ha), T₂- Zinc (15 kg/hac), T₃-Zinc (20 kg/hac), T₄-Phosphorus (10 kg/ha), T₅- Phosphorus (15 kg/ha), T₆- Phosphorus (20 kg/ha), T₇- Zinc (10 kg/ha) + Phosphorus (10 kg/ha), T₈-Zinc (15 kg/hac) + Phosphorus (15 kg/ha), T₉- Zinc (20 kg/hac) + Phosphorus (20 kg/ha). It was observed that treatment T₈ (Zinc (20 kg/hac) + Phosphorus (20 kg/ha)) shows a superior result in growth (Plant height and number of branches). Overall combined application of Zinc (20 kg/hac) + Phosphorus (20 kg/ha) for better growth of chickpea crop.

Keywords: Growth parameters, zinc, phosphorus

1. Introduction

Chickpeas (*Cicer arietinum* L.) are one of the most significant winter legumes produced extensively in arid and rain-fed parts of the world. Rabi is the main season for the cultivation of chickpeas, commonly known as Bengal gram or gram. It is a member of the Leguminosae family. Chickpeas are an annual crop that self-pollinates and is cultivated all over the world for food and other purposes. Muehlbauer and Sarker (2017) [1]. Chickpeas can complete their life cycle in three to six months, depending on the weather at the time of Rabi crops (Ullah *et al.* 2014) [2].

Chickpea contains on the average 22% protein, 4.5% fat, 63% carbohydrate, 8.0% crude fiber and 2.7% ash (Chavan *et al.*, 1986) [3]. Its protein quality is better than other legumes such as pigeon pea, black gram and green gram (Sharma *et al.*, 2013) [4].

Chickpea contains high levels of calcium, iron, niacin, vitamin B, and vitamin C. Its leaves contain malic acid, which is very helpful for digestive issues and blood purification. It is a pulse crop that fixes nitrogen in the soil through a symbiotic relationship. Based on seed colour and geographical distribution, chickpeas are generally grouped into two types: Kabuli (Mediterranean and Middle Eastern origin) and desi (Indian origin). The former type is with large, smooth coated, rams-head shaped and beige-colored seeds and the latter type is with small, angular, wrinkled and dark colored seeds (Chavan *et al.*, 1986, Saini and Knights, 1984, Mino *et al.*, 2009) [3, 5, 6]. Desi cultivars are small and angular in shape, with strong seed coatings and brown seed colors. Desi chickpeas are usually grown in semi-arid tropical environments; in contrast, Kabuli chickpeas are larger and have a smoother seed coat. Temperate climates are used to raise Kabuli chickpeas in regions, because they improve the physical, chemical, and biological qualities of the soil and hold onto atmospheric nitrogen in their root nodules, chickpeas are also crucial for preserving soil productivity. India is the world's largest producer of chickpeas, accounting for over 70% of global production. (Lalrinzuali *et al.*, 2023) [7].

The production of chickpeas in India amounted to over 13.5 million metric tons in 2022. Australia came in second at an estimated 876.5 thousand metric tons of chickpeas. (Anonymous, 2024) [8]. During 2021-22, chickpea production of India was 13.75 million tonnes from an acreage of 10.91 million ha. with a productivity of 12.6 q./ha (DES 2023) [9]. Chickpea solely contributes nearly 50% of the Indian pulse production. States like Maharashtra (25.97% contribution to national

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production), Madhya Pradesh (18.59%), Rajasthan (20.65%), Gujarat (10.10%) and Uttar Pradesh (5.64%) are major chickpea producing states of India (Anonymous 2024) ^[10].

2. Materials and Methods

2.1. Description of experimental site

The study was conducted during the rabi season of 2023-24 at the

Department of Agriculture, Sant Baba Bhag Singh University. The experimental site is located in the trans-Gangetic plains agro-climatic zone of Punjab. It falls within the central plain region of the state at an elevation of 247 m above mean sea level. Geographically, the experimental site lies between 30°33' N latitude and 76°56' E longitude.



Location of experimental site

The experimental site, located in Punjab, experiences both extremely hot summers and cold winters. The normal maximum temperature reaches about 42 °C during summer, while during winter it remains around 25.9 °C. The rainy season generally extends from June to September. The experimental area receives an average annual rainfall of 500–700 mm, with the highest precipitation occurring in July, whereas November is usually the driest month. Chickpea is a cool-season crop and grows well under temperatures ranging from 18 °C to 25 °C.

2.2. Method of data collection and experimental design

The experiment was laid out in a Randomized Block Design (RBD) with three replications. The chickpea variety PBG-7 was used as the planting material. The size of each experimental plot was 1.4 m × 4.3 m. Before sowing, residues and debris from the previous crop were removed from the experimental field. The field was then thoroughly prepared, properly levelled, and adequate drainage was ensured for uniform crop establishment.

Pictorial demonstration of experiment



Plate 1: Field preparation



Plate 2: Field layout



Plate 3: Sowing of chickpea seeds



Plate 4: Tagging of plants for observation



Plate 5: Sowing after 30 days



Plate 6: Flowering Stage



Plate 7: Weed Management



Plate 8: Pod Formation



Plate 9: Green Pod



Plate 10: Harvesting

Data collection and analysis
Observations were recorded at 30, 60, and 90 days after sowing (DAS). The growth parameters measured were plant height and number of branches per plant. For calculating various statistical parameters, the analysis was performed using MS-Excel and OPSTAT for all the characters. The mean values of the data were subjected to the analysis of variance and ANOVA was set for Randomized Block Design.

Results and Discussion
Plant Height (cm)

Phosphorus (P) is an essential plant nutrient that plays a vital role in crop growth and development. It promotes root development, strengthens stems, enhances flowering and grain formation, improves crop quality, increases the nitrogen-fixing capacity of legumes, and enhances resistance against diseases. Application of phosphorus fertilizer has also been reported to improve chickpea yield (Ramesh *et al.*, 2022) [11]. Plant height is one of the important growth parameters used to assess crop performance at different stages of development. In the present study, significant variation in plant height was observed due to different phosphorus and zinc treatments at 30, 60, and 90 days after sowing (DAS), as well as at maturity. Among the treatments, T₉ recorded the maximum plant height, measuring 13.7 ± 0.85 cm, 32.51 ± 0.96 cm, 49.77 ± 0.40 cm, and 55.92 ± 0.54 cm at 30, 60, 90 DAS, and at maturity, respectively. In contrast, the minimum plant height was recorded under T₀, with values of 6.77 ± 0.64 cm, 22.83 ± 0.59 cm, 42.72 ± 0.36 cm, and 49.47 ± 0.58 cm at the corresponding growth stages. The increase in plant height under higher phosphorus and zinc application may be attributed to improved nutrient availability, better root development, and enhanced physiological activity of the plants.

Table 1: Effect of Zinc and Phosphorus sources on plant height (cm) of chickpea

Treatments	Days After Sowing			
	30	60	90	Harvest
T ₀	6.77±0.64	22.83 ± 0.59	42.72±0.36	49.47±0.58
T ₁	7.52±0.22	23.51 ± 0.70	43.87±0.45	51.42±0.44
T ₂	8.60±0.30	25.31 ± 0.39	44.46±0.35	52.42±0.46
T ₃	8.38±0.25	23.28 ± 0.77	42.76±1.30	50.63±0.12
T ₄	8.38 ± 0.25	27.24 ± 0.35	45.19±0.22	52.99±0.23
T ₅	9.14 ± 0.19	27.67 ± 0.49	46.02±0.16	53.29±0.22
T ₆	6.64± 1.09	25.42 ± 1.82	44.14±1.32	51.43±0.12
T ₇	8.13 ±0.19	29.12 ± 0.27	47.36±0.29	53.73±0.58
T ₈	11.3 ± 0.66	30.10 ± 0.32	48.87±0.17	54.64±0.38
T ₉	12.3 ± 0.34	32.51 ± 0.96	49.77±0.40	55.92±0.54
C.D.	1.76	2.17	2.03	1.22
SE(m)	0.59	0.725	0.678	0.407
SE(d)	0.834	1.025	0.959	0.576
C.V.	11.034	4.701	2.579	1.342

*Mean of three replications with standard error
The graphical presentation of plant height with different treatments applied in field are given below

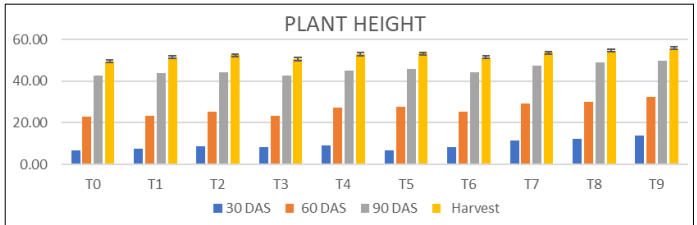


Fig 1: Graphical presentation of Phosphorus and Zinc sources on plant

height (cm) of chickpea

Number of Primary Branches per plant days after sowing (DAS)

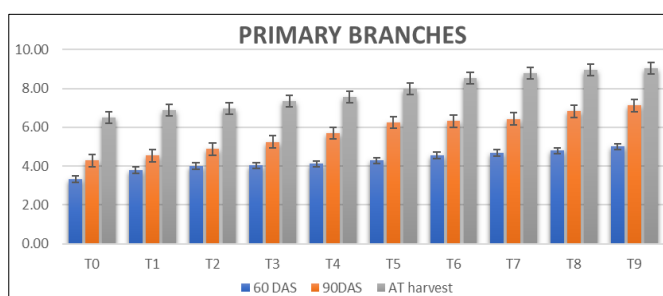
The number of primary branches per plant was recorded at 60 and 90 days after sowing (DAS), and at harvest. The number of primary branches increased rapidly up to 60 DAS, after which only a slight increase was observed as the crop progressed towards maturity. A significant variation in the number of primary branches per plant was observed among the different treatments. Among the treatments, T₉ recorded the highest number of primary branches per plant, with values of 5.00 ± 0.06 , 7.12 ± 0.09 , and 9.03 ± 0.68 at 60 DAS, 90 DAS, and at harvest, respectively. In contrast, the lowest number of primary branches per plant was recorded under T₀, with values of 3.33 ± 0.12 , 4.28 ± 0.03 , and 6.48 ± 0.13 at the corresponding stages. The increase in primary branching under higher phosphorus and zinc application may be attributed to improved nutrient availability, enhanced vegetative growth, and better development of axillary buds. Similar findings regarding the number of primary branches per plant have also been reported by Kaundal.

Table 2: Effect of Zinc and Phosphorus sources on Number of Primary Branches of chickpea

Treatments	Days After Sowing		
	60 DAS	90DAS	AT harvest
T ₀	3.33 ± 0.12	4.28 ± 0.03	6.48 ± 0.13
T ₁	3.79 ± 0.11	4.54 ± 0.15	6.88 ± 0.05
T ₂	3.99 ± 0.08	4.87 ± 0.17	6.97 ± 0.06
T ₃	4.03 ± 0.07	5.25 ± 0.05	7.34 ± 0.07
T ₄	4.11 ± 0.09	5.70 ± 0.03	7.56 ± 0.13
T ₅	4.28 ± 0.19	6.24 ± 0.04	7.93 ± 0.03
T ₆	4.55 ± 0.16	6.31 ± 0.05	8.54 ± 0.02
T ₇	4.68 ± 0.10	6.42 ± 0.05	8.80 ± 0.20
T ₈	4.79 ± 0.14	6.83 ± 0.03	8.96 ± 0.67
T ₉	5.00 ± 0.06	7.12 ± 0.09	9.03 ± 0.68
C.D.	0.175	0.224	0.288
SE(m)	0.058	0.075	0.096
SE(d)	0.083	0.106	0.136
C.V.	2.373	2.254	2.12

DAS= Days after sowing, Mean of three replications plus Standard error

The graphical presentation of primary branches with various treatments apply in field work are given below:

**Fig 2:** Graphical presentation of Zinc and Phosphorus sources on Number of Primary Branches of chickpea**Number of Secondary Branches per plant**

The number of secondary branches per plant was recorded at 60 and 90 days after sowing (DAS), and at harvest. The number of branches increased rapidly up to 60 DAS, after which only a marginal increase was observed as the crop advanced towards maturity. A significant variation in the number of secondary branches per plant was observed among the different treatments. Among the treatments, T₉ recorded the highest number of

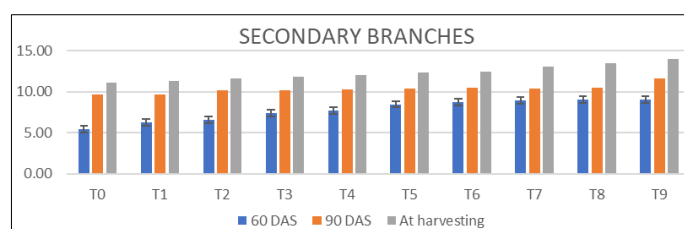
secondary branches per plant, with values of 9.04 ± 0.15 , 11.63 ± 0.86 , and 14.00 ± 0.89 at 60 DAS, 90 DAS, and at harvest, respectively. In contrast, the lowest number of secondary branches per plant was recorded under T₀, with values of 5.47 ± 0.13 , 9.63 ± 0.16 , and 11.13 ± 0.66 at the corresponding stages. The increase in branching under higher phosphorus and zinc application may be attributed to improved nutrient availability, enhanced vegetative growth, and better development of lateral buds.

Table 3: Effect of Zinc and Phosphorus sources on Number of Secondary Branches of chickpea

Treatments	Days After Sowing		
	60 DAS	90DAS	AT harvest
T ₀	5.47 ± 0.13	9.633 ± 0.16	11.13 ± 0.66
T ₁	6.30 ± 0.83	9.703 ± 0.02	11.35 ± 0.85
T ₂	6.59 ± 0.38	10.13 ± 0.39	11.60 ± 1.08
T ₃	7.41 ± 0.13	10.23 ± 0.16	11.85 ± 1.14
T ₄	7.70 ± 0.12	10.33 ± 0.21	12.03 ± 1.27
T ₅	8.48 ± 0.07	10.40 ± 0.30	12.30 ± 1.57
T ₆	8.77 ± 0.06	10.50 ± 0.40	12.47 ± 1.82
T ₇	8.92 ± 0.77	10.40 ± 0.42	13.07 ± 1.17
T ₈	9.02 ± 0.19	10.53 ± 0.36	13.48 ± 1.12
T ₉	9.04 ± 0.15	11.63 ± 0.86	14.00 ± 0.89
C.D.	0.251	0.829	1.348
SE(m)	0.084	0.277	0.45
SE(d)	0.118	0.392	0.637
C.V.	1.866	4.632	6.322

DAS= Days after sowing, Mean of three replications plus Standard error

The graphical presentation of secondary branches with various treatments apply in field work are given below:

**Fig 3:** Effect of Zinc and Phosphorus sources on Number of Secondary Branches of chickpea**Conclusion and Recommendation**

Chickpea is one of the oldest legume crops and it's the second most important crop worldwide. Chickpea serve as a rich source of protein, fiber, and vitamins and is as staple food of vegetarian's people. Indian farmers prefer growing chickpea as compared to other pulses because of easy cultivation, good yields, chickpea and its better adaptability to the various cropping system. The findings of the study experiment revealed that the combination of Zinc and phosphorus have shown positive results on growth. This might be due to its enzymatic role in starch formation and in protein synthesis. The increase in the availability of zinc to plant might have stimulated the metabolic and enzymic activities thereby increasing the growth of crop. Zinc is involved in starch formation, growth promoting substance like auxin, seed maturation and production and also plays a vital role in protein

synthesis.

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