Original Research Article

Influence of Nitrogen and Zinc levels on growth and yield of Chickpea (*Cicer arietinum L*)

ABSTRACT

Background: Chickpea is the largest produced food legume in south Asia and the third largest globally, after common bean (*Phaseolus vulgaris* L.) and field pea (*Pisum sativum* L.) Bengal gram is widely appreciated as health food. It is a protein-rich supplement to cereal-based diets, especially to the poor in developing countries.

Objectives: Effect of Nitrogen and Zinc levels on growth and yield of Chickpea.

Methods: With the goal of studying the effect of nitrogen and zinc levels on growth and yield of chickpea (*Cicer arietinum* L.) var Pusa-362 under a Randomized Block Design with 9 treatments each replicated thrice. The results reported that the application of 30 kg/ha Nitrogen+15kg/ha Zinc (treatment -9) recorded significantly higher plant height (58.40 cm), maximum number of nodules/plant (12.10), higher plant dry weight (24.0 g/plant), Maximum number of pods/plant (71.10), higher seeds/pod (1.80), higher seed yield (3.21 t/ha) and higher stover yield (4.31 t/ha) were recorded in (treatment -9) that is with 30kg/ha Nitrogen+15kg/ha Zinc.

Conclusion: Based on the above findings of the investigation it may be concluded that treatment with 30kg/ha Nitrogen and 15kg/ha Zinc performed exceptionally in all growth and yield parameters and in obtaining higher grain yield of chickpea These findings are based on one season therefore, further trial may be required for further confirmation.

***Keywords**: Chickpea, Nitrogen, Zinc, Growth parameters and Yield*

INTRODUCTION

Chickpea (*Cicer arietinum L.*) is an important grain legume crop in the world which was globally, total production is approximately 14.2 m t from an area of 14.8 m ha and a productivity of 0.96 t/ha **[1].** South East Asia, led by India is leading producers, while in East Africa, Ethiopia, Tanzania, Malawi, and Kenya are leading chickpea producers. Worldwide chickpea is largely grown as a rain fed crop (> 90%) in the arid and semiarid environments in Asia and Africa. Chickpea, almost in all regions, is grown on marginal soils and the good soils are used for growing other more favored crops. For obtaining high grain yield proper management of the crop is must and proper nutrient management is one of the important factors contributing towards high productivity.

Chickpea (*Cicer arietinum L.*) is the fourth largest grain legume crop in the world, with a total production of 13.1 m t from an area of 13.5 m ha and productivity of 0.97 t/ha **[1].** India is one of the important chickpea growing countries in Asia with an area of 9.6 m ha and production of 8.83 m t **[1].** India ranked first in area and production in the world. Chickpea also plays an important role in sustaining soil productivity by improving its physical, chemical and biological properties and trapping atmospheric nitrogen in their root nodules **[2].**

Chickpea also plays important role in increasing soil fertility due to its nitrogen fixingability and micronutrient deficiency Zinc is major problem of now days because of use of high yielding varieties, intensive cropping system, inadequate supply of micronutrient and loss of organic matter content by erosion and pollution. Zinc application influence on synthesis of Auxin, nodulation and nitrogen fixation which enhance the plant growth and development of crop and ultimately influence the seed yield **[3].** Application of Zinc enhance quality and yields of chickpea reported by **[4].**

Nitrogen is vital for crops because it is a major constituent of chlorophyll, the compound by which plants use sunlight energy to produce sugars from water and carbon dioxide that is photosynthesis. It is correspondingly a major factor of amino acids, the building blocks of proteins. Lacking proteins, plants wither and die. The main nutrients are required for plant growth are nitrogen (N), phosphorus (P), and potassium (K) and the use of nitrogen fertilizer outcomes in improved crop production costs and atmospheric pollution. Numerous plant particles such as amino acids, chlorophyll, nucleic acids, ATP and phytohormones, that contains nitrogen as a basic part, are required to complete the biological processes, involving carbon and nitrogen metabolisms, photosynthesis and protein production. Nitrogen application is more important than the other major important fertilizers/nutrients for successful crop production **[5].**

Zinc deficiency has been aggravated in Indian soils due to tremendous increase in cropping intensity and adoption of cultivation of high yielding varieties. Zinc is the major component of several enzymes, influencing the synthesis of proteins, auxins and photosynthetic activity. It also increases plant`s resistance to dry and hot weather conditions which are known to affect chickpea productivity **[6].**

Being a leguminous crop, it is capable to fix atmospheric Nitrogen in the soil and hence. Requirement of nitrogen similarly zinc is also an important micro nutrient element which increases resistance to disease in plant. Applying zinc increased yield and quality of chickpea. Now days, wide spreads deficiency of zinc is observed in various part of country which limit to the production of crops. Zinc applications has been noticed in chickpea grown on zinc deficient soil. Nitrogen and Zinc application improved the fertility status of soil and produce higher grain yield of chickpea. A field study was under taken to assess the effect of nitrogen and zinc on growth and yield of Chickpea.

MATERIALS AND METHODS

A field experiment was conducted during Rabi season of 2021-22, at Crop research farm of Department of Agronomy at Sam Higginbottom University of Agriculture, Technology, And Sciences, Prayagraj which is located at 25^o 24' 42" N latitude, 81^o 50' 56" E longitude and 98 m altitude above the mean sea level (MSL). The experiment was conducted in Randomized Block Design with 9 treatments each replicated thrice. Each treatment net plot size is 3m × 3m. The treatment are categorized as with recommended Phosphorous through DAP and potash through Muriate of Potash, in addition with Nitrogen was applied through Urea and Zinc through Zinc sulphate when applied in combinations as follows, T_1: 10kg/ha Nitrogen + 5kg/ha Zinc, T_2: 10kg/ha Nitrogen + 10 kg/ha Zinc, T_3: 10kg/ha Nitrogen + 15kg/ha Zinc, T_4: 20kg/ha Nitrogen + 5kg/ha Zinc, T_5: 20kg/ha Nitrogen + 10kg/ha Zinc, T_6: 20kg/ha Nitrogen + 15kg/ha Zinc, T_7: 30kg/ha Nitrogen+5kg/ha Zinc, T_8: 30kg/ha Nitrogen+ 10kg/ha Zinc, T_9: 30kg/ha Nitrogen+ 15kg/ha Zinc.Growth parameters viz. plant height (cm), number of nodules/plant and plant dry weight(g) were recorded manually on five randomly selected representative plants from each plot of each replication separately and after harvesting, seeds were separated from each net plot and were dried under sun for three days. Later winnowed, cleaned and grain yield was computed and expressed in t/ha. After complete drying under sun for 10 days stover yield from each net plot was recorded and expressed in t/ha. The data was computed and analysed by following statistical method **[7].**

RESULTS AND DISCUSSION

Plant height (cm)

At harvest, significantly higher plant height (58.40 cm) was recorded in treatment-9 (30kg/ha Nitrogen+15kg/ha Zinc). However, treatment-8 (30kg/ha Nitrogen+10kg/ha Zinc) was found to be statistically at par with treatment-9 (30kg/ha Nitrogen+15kg/ha Zinc) [Table 1]. Significantly plant height was due to the response to with application of N fertilizers which might have been due to promote hasten growth in terms of higher plant height. The similar findings were reported **[8].** Further, Increase in plant height might be due to involvement of zinc in different physiological processes like enzyme activation, electron transport, chlorophyll formation, stomatal regulation etc, With the increase in levels of zinc the plant height gradually increased, which have attributable to greater photosynthetic activity and chlorophyll synthesis by zinc fertilization resulting into better vegetative growth. Similar results were reported by **[9].**

Number of Nodules/plant

Significant and maximum number of nodules/plant (12.10) was recorded in treatment-9 (30kg/ha Nitrogen+15kg/ha Zinc). However, treatment-8 (30kg/ha Nitrogen+10kg/ha Zinc) was found to be statistically at par with treatment-9 (30kg/ha Nitrogen+15kg/ha Zinc) [Table1]. Significant and maximum number of nodules/plant was application of zinc could have be ascribed to its pivotal role in regulating the nodulation in pulses. Zn acts as antioxidant and its application helps in reducing the lipid per oxidation and hydrogen peroxide concentration in plant and also involved in the functioning of transcriptional regulators responsible for nitrogen fixation **[10].**

Plant dry weight

Significantly higher plant dry weight (24.00 g) was recorded in treatment-9 (30 kg/ha Nitrogen+15 kg/ha Zinc). However, treatment-8 (30kg/ha Nitrogen+10kg/ha Zinc) was found to be statistically at par with treatment-9 (30kg/ha Nitrogen+15kg/ha Zinc) [Table1]. Significantly higher plant dry weight was with application of Zinc which might be due to influenced the plant vigor through absorption of nutrients at critical stages that enhance the physiological activity of crop and increase the assimilation of photosynthates ultimately increasing the dry matter accumulation. Similar results were also reported by **[11].**

Table 1. Effect of nitrogen and zinc levels on growth parameters of chickpea.

S.No	Treatments	Plant height (cm) (At harvest)	Nodules/plant (At harvest)	Plant Dry weight (At harvest)
1.	10kg/ha Nitrogen+5kg/ha Zinc	52.6	7.0	17.4
2.	10kg/ha Nitrogen+10kg/ha Zinc	54.1	7.7	18.6
3.	10kg/ha Nitrogen+15kg/ha Zinc	54.6	8.7	19.8
4.	20kg/ha Nitrogen+5kg/ha Zinc	54.9	8.2	19.1
5.	20kg/ha Nitrogen+10kg/ha Zinc	56.0	9.4	21.5
6.	20kg/ha Nitrogen+15kg/ha Zinc	56.1	10.1	21.7
7.	30kg/ha Nitrogen+5kg/ha Zinc	55.7	9.6	20.3
8.	30kg/ha Nitrogen+10kg/ha Zinc	56.9	11.5	22.7
9.	30kg/ha Nitrogen+15kg/ha Zinc	58.4	12.1	24.0
	SEm (±)	0.52	0.51	0.42
	CD (P 0.05)	1.55	1.54	1.27

Yield Attributes:

Number of Pods/plant

Significant and maximum number of pod/plant (71.10) was recorded in T_9[30 kg/ha Nitrogen+ 15kg/ha Zinc]. However, treatment-8 (30kg/ha Nitrogen+10kg/ha Zinc), treatment-5 (20kg/ha Nitrogen+10kg/ha Zinc) and treatment-6 (20kg/ha Nitrogen+15kg/ha Zinc) were found to be statistically at par with the treatment-9 (30 kg/ha Nitrogen+15 kg/ha Zinc) [Table2]. Significantly maximum number of pods/plant was with application of Nitrogen might be due to the enhanced early vegetative growth in terms of higher dry matter accumulation and vigorous root system resulted in more branches which consequently increased the number of pod bearing branches significantly. Similar findings were reported by **[12].**

Number of Seeds/Pod

Significantly higher number of seeds/pod (1.80) was recorded in Treatment 9 [30kg/ha Nitrogen +15 kg/ha]. However, treatment-8 (30 kg/ha Nitrogen+10 kg/ha Zinc) was found to be statistically at par with the treatment-9 (30 kg/ha Nitrogen+15 kg/ha Zinc) [Table 2]. Significantly higher number of seeds/pod might be due to with application of 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 so that there will be increase in no of seed per pod . The similar results were observed by **[13].**

Seed yield (t/ha)

Significantly higher seed yield (3.21 t/ha) was recorded in Treatment-9 [30 kg/ha Nitrogen + 15 kg/ha Zinc]. However, treatment-8 (30 kg/ha Nitrogen+10 kg/ha Zinc) was found to be statistically at par with the treatment-9 (30 kg/ha Nitrogen+15 kg/ha Zinc) [Table 2] Significantly higher Seed yield was increased with application of higher doses of nitrogen, which increased might have due to the photosynthetic activity and increased vegetative growth and yield attributes also improved ultimately increased in seed yield. Similar findings have been observed by **[14].** Zinc play a vital role in increasing seed yield because zinc takes place in many physiological process of plant such as chlorophyll formation, stomatal regulation, starch utilization which enhance seed yield. Zinc also converts ammonia to nitrate in crops which contribute to yield. Theseresults are in confirmatory with the work **[15].**

Stover yield (t/ha)

Significantly higher stover yield (4.31 t/ha) was recorded in Treatment-9 [30 kg/ha Nitrogen + 15 kg/ha Zinc]. However, treatment-8 (30 kg/ha Nitrogen+10 kg/ha Zinc) was found to be statistically at par with the treatment-9 (30 kg/ha Nitrogen+15 kg/ha Zinc) [Table 2]. Significantly higher stover yield with application of zinc might have increase in photosynthetic rate and there by increased dry matter production and translocation from source to sink. Similar findings **[16].**

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

S.no	Treatments	Number of Pods/plant	Number of Seeds/pod	Seed index (g)	Seed yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
1	10kg/ha Nitrogen+5kg/ha Zinc	50.6	1.1	19.60	2.29	3.24	44.95
2	10kg/ha Nitrogen+10kg/ha Zinc	57.1	1.1	19.87	2.39	3.283	42.14
3	10kg/ha Nitrogen+15kg/ha Zinc	61.9	1.3	20.54	2.53	3.45	42.63
4	20kg/ha Nitrogen+5kg/ha Zinc	60.7	1.3	21.13	2.56	3.63	41.65
5	20kg/ha Nitrogen+10kg/ha Zinc	64.5	1.3	21.78	2.66	3.79	41.09
6	20kg/ha Nitrogen+15kg/ha Zinc	66.4	1.3	22.26	2.83	3.87	41.61
7	30kg/ha Nitrogen+5kg/ha Zinc	59.3	1.3	21.63	2.64	3.75	41.13
8	30kg/ha Nitrogen+10kg/ha Zinc	68.1	1.7	22.57	3.10	4.22	43.43
9	30kg/ha Nitrogen+15kg/ha Zinc	71.1	1.8	23.07	3.21	4.31	42.04
	F- test	S	S	S	S	S	NS
	SEm (±)	2.19	0.06	0.32	0.06	0.06	1.11
	CD (5%)	6.55	0.19	0.97	0.19	0.19	-----

CONCLUSION

Based on the above findings of the investigation it may be concluded that treatment with 30kg/ha Nitrogen and 15kg/ha Zinc proved to be most advantageous to farmers, resulting in plant height (58.40 cm), number of nodules/plant (12.10), plant dry weight (24.0 g/plant), number of pods/plant (71.10), higher seeds/pod (1.80), higher seed yield (3.21 t/ha) and higher stover yield (4.31 t/ha) respectively.

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