

Original Research Article

Effect of Zinc and Molybdenum on growth and yield of chickpea

Abstract

A field experiment was conducted to find out the Effect of Zinc and Molybdenum on growth and yield of chickpea (var. Pusa 362) with ten treatments in the *rabi* 2022. With the different levels of Zinc (5, 10, 15 kg ZnSO₄/ha) and Molybdenum (1, 1.5, 2 kg/ha) respectively, at Crop Research Farm, Department of Agronomy, Faculty of Agriculture, SHUATS, Prayagraj, Uttar Pradesh. By all these findings higher Plant height (45.75cm), number of nodules/plant (20.78) dry weight (44.51g) Also, significantly higher number of pods/plant (32.65), number of seeds/pod (1.64), seed index (22.95g), seed yield (3.06 t/ha), stover yield (4.16 t/ha) and higher gross returns (INR 2,01,500.00), net returns (INR 1,54,383.00) and B:C ratio (3.27) was recorded in treatment with the application of Zinc 15 kg/ha + Molybdenum 2 kg/ha.

Key words: *Chickpea, Zinc, Molybdenum, Growth, Yield and Economics.*

Introduction :

Chickpea (*Cicer arietinum L.*) Chickpea is an important crop for vegetarian people as primary source of protein, it is third most important pulse crop grown in the world after dry beans and peas. These foods are essential nutritionally and economically since millions of people consume them worldwide. Indian vegetarians rely heavily on pulses as a source of protein and Supplement the meals main grains with proteins, vital amino acids, vitamins, and minerals They have 22 to 24% protein, which is roughly twice as much as wheat and three times as much as rice . Pulses are recognized to lower numerous non communicable illnesses including colon cancer and cardiovascular diseases in addition to offering considerable nutritional and health advantages (**Jukanti *et al.*, 2012**).

Pulse production in India is about 25.72 million tones with area under cultivation of around 288.3 lakh hectares and pulse production in Uttar Pradesh is 2.62 million tones with

area under cultivation of around 0.81 lakh hectares (**GOI 2021**). In India chickpea had a lion share of 49.3% in total pulse production (**ICRISAT 2021**), signifying its importance in Indian agricultural production.

Zinc is essential for the creation of carbs and chlorophyll. Several enzyme systems, auxin, and protein synthesis all need zinc either directly or indirectly. It is thought that zinc encourages the creation of RNA, this again is required for the creation of protein. Due to a lack of micronutrients in the soil, namely Zn, in numerous locations, normal crop production could not be reached despite the prudent application of NPK fertilizers. According to (**Ray *et al.*, 2014**) a 100 g serving of edible chickpeas typically contains 2.2–20 mg of zinc.

Molybdenum is a crucial element needed by bacteria for nitrogen fixation. It is a structural part of the nitrogenase enzyme, which is crucial for iron absorption and translocation in both plants and seeds as well as actively involved in nitrogen fixation by Rhizobium bacteria in the root nodules of leguminous crops.

Material and Methods:

The experiment was carried out during *Rabi* 2022 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.) which is located at 25° 24' 42" N latitude, 81° 50' 56" E longitude and 98 m altitude above the mean sea level. This area is situated on the right side of the river Yamuna by the side of Prayagraj Rewa Road about 5 km away from Allahabad city. The soil samples were collected randomly from 0 to 15 cm depth from 5 spots of the experimental field just before layout of experiment. A representative homogenous composite sample was drawn by mixing all these soil samples together, which was analyzed to determine the physicochemical properties of the soil. The experiment was conducted in Randomized Block Design consisting of 10 treatment combinations with 3 replications and was laid out with the different treatments allocated randomly in each replication. Fertilizers were applied as band placement, for which 4-5 cm deep furrows were made along the seed rows with a hand hoe. The nutrient sources were urea, single super phosphate (SSP), Muriate of potash (MOP) and zinc sulphate to fulfill the requirement of N, P₂O₅, K₂O and ZnSO₄/ ha. The recommended dose of 20:60:20 N: P: K kg / ha and Phosphorus, zinc was applied as per recommended dosage.

Seedlings were thinned out in order to maintain spacing of 30 cm x 10 cm. The growth parameters and yield, production was recorded at harvest from randomly selected plants in each plot. The data was computed and analysed by following statistical method of **Gomez and Gomez (1984)**.

Result and Discussion

A. Effect of Zinc and Molybdenum on plant height (cm) of Chickpea.

Data presented in Table 1, tabulated with parameter plant height (cm) of Chickpea and there was increasing in crop age plant height was progressively increased with the advancement of the experimentation. The plant height was significantly higher in all different growth intervals with the levels of Zinc (Zn) and Molybdenum (Mo). The significantly higher plant height (45.75 cm) was recorded in treatment 9 (Zinc 15 kg/ha + Molybdenum 2 kg/ha) at 100 DAS. However, the treatment 8 (Zinc 15 kg/ha + Molybdenum 1.5 kg/ha) (44.82cm) was found to be statistically at par with treatment 9 (Zinc 15 kg/ha + Molybdenum 2 kg/ha). The increase in growth of plants under Zinc treatment (20 kg/ha) may also be due to its effect in the metabolism of growing plants, which may effectively explain the observed response of Zinc application on plant height **Masih et al., (2020)**. Whereas, Mo also resulted an increase in plant height might be due to enhanced chlorophyll formation which enhances photosynthesis resulting an increase in yield. By combined application of zinc and molybdenum resulted a positive impact on growth. Similar results were reported by **Chakraborty (2009); Rashid et al., (2011); Karpagam et al., (2014)**.

B. Effect of Zinc and Molybdenum on number of nodules/plant of Chickpea.

Data presented in Table 2, Observations regarding the response of different levels of Zinc 5, 10, 15 kg/ha and Molybdenum (1,1.5,2 kg/ha) treatments on number of nodules/plant of chickpea are given in Table 2 It was noticed that successive stage there was an incremental trend.. The significantly higher number of nodules/plant (20.78) was recorded in treatment 9 (Zinc 15 kg/ha + Molybdenum 2 kg/ha) at 100 DAS. Significant and maximum number of nodules 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 nitrogenfixation. Application of Mo in combination found increased nodulation number significantly. Molybdenum is an essential trace element and is vital for synthesis and activity of molybdo enzymes such as nitrogen assimilation enzyme-nitrate reductase and the nitrogen fixing enzyme-nitrogenase, the key regulatory component for initiation of nodulation and maintenance of nitrogen fixation in legumes. Similar observations were recorded by **Khan *et al.*, (2014); Upadhyay *et al.*, (2016).**

C. Effect of Zinc and Molybdenum on Plant dry weight of Chickpea

Data presented in Table 2, Observations regarding the response of different levels of Zinc 5, 10, 15 kg/ha and molybdenum (1,1.5,2kg/ha) treatments on plant dry weight of chickpea are given in Table 2 It was noticed that successive stage there was an incremental trend.. At 100 DAS. The significantly higher plant dry weight (44.51 g/plant) was recorded in treatment 9 (Zinc 15 kg/ha + Molybdenum 2 kg/ha) at 100 DAS. However, the treatment 8 (Zinc 15 kg/ha + Molybdenum 1.5 kg/ha) (44.39 g/plant) were found statistically at par with treatment9 (Zinc 15 kg/ha + Molybdenum 2 kg/ha). Increase in plant dry weight was with application of Zinc (20kg/ha) which may have Zinc plays an activator of several enzymes in plants and it is directly involved in the biosynthesis of growth substances such as auxin there by producing more plant cells and enhanced dry matter(**Chatterjee *et al.*, 2017).**

D. Effect of Zinc and Molybdenum on yield and yield attributes of Chickpea.

At 100 DAS significantly higher number of pods/plant (32.65) was recorded with the application of (Zinc 15 kg/ha + Molybdenum 2 kg/ha) over all the treatments. Significantly higher number of seeds/pod (1.64) was recorded in treatment 9 (Zinc 15 kg/ha + Molybdenum 2 kg/ha) over all the treatments. Significantly maximum seed index (22.95 g) was recorded in treatment 9 (Zinc 15 kg/ha + Molybdenum 2 kg/ha) over all the treatments. However, the treatment 8 (Zinc 15 kg/ha + Molybdenum 1.5 kg/ha) (22.85) was found to be statistically at par with treatment 9 (Zinc 15 kg/ha + Molybdenum 2 kg/ha).

Significantly higher seed yield (3.06 ta/ha) was recorded in treatment 9 (Zinc 15 kg/ha + Molybdenum 2 kg/ha) over all the treatments. However, the treatment 8 (Zinc 15 kg/ha + Molybdenum 1.5 kg/ha) (3.00 ta/ha) were found to be statistically at par with treatment 9 (Zinc 15 kg/ha + Molybdenum 2 kg/ha). Significantly higher stover yield (4.16 ta/ha) was recorded in treatment 9 (Zinc 15 kg/ha + Molybdenum 2 kg/ha) over all the treatments. However, the treatment 8 (Zinc 15 kg/ha+ Molybdenum 1.5 kg/ha) (3.94 ta/ha) was found to be statistically at par with treatment 9 (Zinc 15 kg/ha + Molybdenum 2 kg/ha). Significantly higher harvest index (42.38%) was recorded in treatment 9 (Zinc 15 kg/ha + Molybdenum 2 kg/ha) over all the treatments. However, the treatment 8 (Zinc 15 kg/ha + Molybdenum 1.5 kg/ha), was found to be statistically at par with treatment 9 (Zinc 15 kg/ha + Molybdenum 2 kg/ha). The plant performance in terms of yield attributing characters such as number of pods per plant, seed yield per plant and seed index were significantly influenced. This could be attributed to increase the availability of micronutrients with each successive level of micronutrients and its positive effect on growth attributes and subsequently on yield components. Combined application of Zn and Mo helped in translocation of photosynthates to pods and seeds. Working with different crops other researchers have also reported increased yield with application of Zn. These results are in agreement with the findings of **Rashid *et al.* (2011)**. Higher 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 observed by **Valenciano *et al.*, (2010)**. Seed and stover yield of chickpea was significantly influenced with increasing levels of micronutrients. This is perhaps due to the combined application of Zn and Mo which enhanced the survival and multiplication of microorganisms, improved nitrogen fixation, transport of sugars and better uptake and assimilation of available nutrients by the plants during the entire growth period. Similar results have been reported by the findings of **Chakraborty *et al.*, (2009)**.

Table 1. Effect of Zinc and Molybdenum on Growth attributes of Chickpea.

S No	Treatments	Plant height (cm)	Number of nodules/plant	Plant dry weight (g/plant)
1.	Zinc 5 kg/ha + Molybdenum 1 kg/ha	43.12	37.18	36.59
2.	Zinc 5 kg/ha + Molybdenum 1.5 kg/ha	43.21	38.89	39.32
3.	Zinc 5 kg/ha + Molybdenum 2 kg/ha	43.54	40.92	41.02
4.	Zinc 10 kg/ha +Molybdenum 1 kg/ha	43.76	41.84	42.08
5.	Zinc 10 kg/ha + Molybdenum 1.5 kg/ha	43.98	42.87	42.72
6.	Zinc 10 kg/ha + Molybdenum 2 kg/ha	44.24	43.68	43.48
7.	Zinc 15 kg/ha + Molybdenum 1 kg /ha	44.56	43.88	44.00
8.	Zinc 15 kg/ha + Molybdenum 1.5 kg /ha	44.82	44.74	44.39
9.	Zinc 15 kg/ha + Molybdenum 2 kg/ha	45.75	44.81	44.51
10.	Control (RDF-20:60:20 NPK kg/ha)	42.94	37.25	33.56
	F-test	S	S	S
	Sem±	0.60	0.47	0.54
	CD at 5%	1.55	0.97	1.27

Table 2. Effect of Zinc and Molybdenum on yield attributes and yield of Chickpea.

S.No.	Treatments	No of pods/plant	No of seeds/pod	Seed index	Seed yield (t/ha)	Stover yield (t/ha)	Harvest Index (%)
1	Zinc 5 kg/ha + Molybdenum 1 kg/ha	25.57	1.22	19.45	2.24	3.21	41.10
2	Zinc 5 kg/ha + Molybdenum 1.5 kg/ha	26.67	1.25	19.52	2.36	3.38	41.11
3	Zinc 5 kg/ha + Molybdenum 2 kg/ha	26.85	1.28	20.67	2.47	3.43	41.86
4	Zinc 10 kg/ha + Molybdenum 1 kg/ha	27.39	1.31	20.73	2.54	3.55	41.70
5	Zinc 10 kg/ha + Molybdenum 1.5 kg/ha	28.45	1.35	21.61	2.66	3.64	42.22
6	Zinc 10 kg/ha + Molybdenum 2 kg/ha	29.72	1.41	21.86	2.75	3.75	42.30
7	Zinc 15 kg/ha + Molybdenum 1 kg /ha	30.70	1.49	22.73	2.86	3.88	42.45
8	Zinc 15 kg/ha + Molybdenum 1.5 kg /ha	31.90	1.57	22.85	3.00	3.94	43.25
9	Zinc 15 kg/ha + Molybdenum 2 kg/ha	32.65	1.64	22.95	3.06	4.16	42.38
10	Control (RDF-20:60:20 NPK kg/ha)	25.70	1.18	18.25	2.08	3.17	39.59
	F test	S	S	NS	S	S	NS
	SEm±	0.06	5.16	0.14	8.35	6.81	0.47
	CD (P = 0.05)	0.19	15.34	--	0.02	0.11	--

Table 3. Effect of Zinc and Molybdenum on economics of Chickpea.

S.No.	Treatments	Cost of cultivation (INR/ha)	Gross return (INR)	Net return (INR/ha)	B:C ratio
1	Zinc 5 kg/ha + Molybdenum 1 kg/ha	44,417	1,45,600	1,01,183	2.27
2	Zinc 5 kg/ha + Molybdenum 1.5 kg/ha	45,417	1,53,400	1,07,983	2.37
3	Zinc 5 kg/ha + Molybdenum 2 kg/ha	46,417	1,60,550	1,14,133	2.45
4	Zinc 10 kg/ha + Molybdenum 1 kg/ha	44,767	1,65,100	1,20,333	2.68
5	Zinc 10 kg/ha + Molybdenum 1.5 kg/ha	45,767	1,72,900	1,27,133	2.77
6	Zinc 10 kg/ha + Molybdenum 2 kg/ha	46,767	1,78,750	1,31,983	2.82
7	Zinc 15 kg/ha + Molybdenum 1 kg/ha	45,117	1,85,900	1,40,783	3.12
8	Zinc 15 kg/ha + Molybdenum 1.5 kg/ha	46,117	1,95,000	1,48,883	3.22
9	Zinc 15 kg/ha + Molybdenum 2 kg/ha	47,117	2,01,500	1,54,383	3.27
10	Control (RDF-20:60:20 NPK kg/ha)	42,067	1,35,200	93,133	2.21

CONCLUSION

It is concluded that in Chickpea with the application of Zinc 15 kg/ha + Molybdenum 2 kg/ha in (treatment 9) recorded higher Growth, yield and Benefit cost ratio which is beneficial for farmers. Since the findings are based on one season, further trails are needed to confirm the results.

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