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Influence of Rate of Zinc fertilization on Growth, Yield Attributes and Yield in Blackgram (*Vigna mungo* L.) Varieties

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ABSTRACT

A field experiment was conducted to study the influence of rate of zinc fertilization on growth, yield attributes and yield in blackgram (*Vigna mungo* L.) varieties at Agricultural College Farm, Bapatla during *Rabi*, 2021. The experiment was laid out in split plot design with three main treatments of Zn levels (0, 25 and 50 kg ha^{-1}) and five sub treatments of blackgram varieties (LBG 752, LBG 787, TBG 104, GBG 1 and PU 31) replicated three times. The results of experiment revealed that both growth parameters (plant height, drymater production) and yield parameters (number of pods per plant, seed yield, haulm yield, harvest index) were significantly increased with increased levels of Zn application. Soil application of zinc @ 50 kg Zn ha^{-1} had recorded significantly highest values of both growth and yield parameters and it was on par with soil application of zinc @ 25 kg ha^{-1}. Among cultivars, PU 31 performed well and was on par with LBG 752 and TBG 104 in most of the parameters were considered.

Keywords: *Blackgram varieties,Growth parameters,Yield parameters and Zinc levels.*

Zinc is one of the important essential micronutrients in plant nutrition as it involved in various metabolic processes, enzymatic reactions, oxidation-reduction reactions and an essential component of many enzymes such as proteinases, dehydrogenase, carbonic anhydrase, peptidases and superoxide dismutase. In addition, Zn is required for nitrogen metabolism, protein synthesis and auxins metabolism in plant system. Therefore, Zn deficiency causes sever reduction in growth and development of crop and also quality of crop produce often impaired. Among all micronutrients, Zn deficiency is wide spread micronutrient deficiency problem in Indian soils to an extent of 60% of the cultivable area (Singh *et al*., 2005). Zn deficiency is prevailing mostly in sandy soils, calcareous, peat soilsand soils with high phosphorus and silicon content. Supply of Zn fertilizers can temporarily help the offset of plant Zn deficiency symptoms. Hence, this study was taken up with an objective of effect of rate of zinc fertilization on growth and yield of blackgram.

MATERIAL AND METHODS

A field experiment was conducted at Agricultural College Farm, Bapatla during *Rabi*, 2021. The experiment was undertaken on clay textured soil having very slightly alkaline reaction (pH 7.42) and non-saline (EC 0.57 dSm^{-1}) salt concentration. Soil had medium organic carbon (5.7 g kg^{-1}), available P_2O_5 (39 kg ha^{-1}) and K_2O (302 kg ha^{-1}) but low in N content (213 kg ha^{-1}) and sufficient concentration of all micro nutrients(Fe, Mn, Cu and Zn). The experiment was split plot design consisting fifteen treatments and replicated thrice. The main plot treatments comprising three levels of Zn application *viz*., M_1- 0 kg Zn ha^{-1}, M_2- 25kg Zn ha^{-1}and M_3 - 50 kg Zn ha^{-1}and sub plot treatments comprising five blackgram varieties namely, S_1 - LBG 752, S_2 - LBG 787, S_3 - TBG 104, S_4 - GBG 1 and S_5 - PU 31. At the time of sowing, a uniform dose of NPK @ 20:50:0 kg ha^{---}-----^{1} has been given to all plots as basal dose through urea and SSP respectively. Zinc sulphate was applied to all main treatments (M , M, and Mf) through zinc sulphate hepta hydrate (ZnSO,, .7H_2O) at three levels (0, 25 and 50 kg ha^{-1}) to the respective plots as per the treatments as basal before sowing.

The blackgram crop was sown at proper moisture in the 2nd week of November, 2021. The crop was raised with all the standard package of practices and timely protection measures. Biometric observations were collected at pod development and harvest stages of crop by adopting standard methods. Soil samples were collected from each plot from 0 to 15 cm depth at initial, pod development and harvest stages of crop. The samples were analyzed for physical, physico-chemical and chemical properties using standard procedures in the laboratory.The data were analyzed statistically as suggested by Panse and Sukhathme (1978) for split plot design.

RESULTS AND DISCUSSIONS

Data pertaining to the growth parameters of balckgram at different stages of crop are furnished in tables 1 & 2.

Pant Height (cm)

Data presented in the table 1 reveled that soil application of zinc @ 50 kg Zn ha^{-1} had shown all significant values of plant height (cm) at both stages of crop. The highest plant height (39.0 and 41.8 cm) was observed under the treatment M_3 *i.e.,* 50 kg Zn ha^{-1} and it was on par with the treatment M_2 (36.4 and 39.8 cm)(25 kg Zn ha^{-1}). The least plant height (33.5 and 35.8 cm) was recorded in treatment M_1 at pod development and harvest stages of crop respectively. Increment in plant height might be due to increave in internodal distance (Mohsin., 2014). The results are in conformity with the findings of (Sharma and Abraham, 2010), Samreen *et al*. (2013) and Sitaram (2013).

Among subplot treatments, LBG 752 (S_1) recorded significantly higher plant height (39.9 and 43.1 at cm) and it was on par with LBG 787 (S_2). Whereas on the lowest plant height was noted with TBG 104 (S_4). Interaction effects of Zn levels and blackgram varieties on plant height were found non-significant.

Dry Matter Production (kg ha^{-1})

From the data (Table 2) it was revealed that among all main plot treatments, treatment M_3 (50 kg Zn ha^{-1}) had recorded highest drymatter production (1809 and 4891 kg ha^{-1}) at pod development stages and harvest which was on par with the treatment M_2(25 kg Zn ha^{-1}) (1781 and 4641 kg ha^{-1}) and significantly superior over M_1 (control) (1546 and 3570 kg ha^{-1}) at pod development and harvest stages of crop, respectively. Whereas, the results were in accordance with reports of Slaton *et al*. (2005) Harris et al. (2007) who stated that zinc application increased the total drymatter production. Crop plant supplied with adequate Zn quantity results in increase plant height, number of leaves which may attributed to significant increase in drymatter accumulation. The results were in line with findings of those observed by Slaton *et al*. (2005), Arsheware*t al*. (2018) and Shakoor *et al*. (2018).

Among blackgram varieties, the highest drymatter production (1783 and 4582 kg ha^{-1}) was noted with LBG 752 (S_1) which was on par with LBG 787 (S_2- 1766 and 4463 kg ha^{-1}) and PU 31 (S_5 – 1707and 4390 kg ha^{-1}) and significantly higher over TBG 104 (S3 - 1627 and 4293 kg ha^{-1}) and GBG 1 (S_4-1627 and 4108 kg ha^{-1}) at pod development and harvest stages of crop, respectively. Interaction effects of Zn levels and blackgram varieties on drymatter production have been found non-significant.

Yield Attributes and Yield Parameters

The data pertaining to yield attributes and yield parameters are furnished in the tables from 3 to 6.

Number of Pods Per Plant

Results from present investigation reveled that soil application of zinc @ 50 kg ha^{-1}significantly increased the number of pods per plant at harvest as compared to control (Table 3). Among different levels of Zn application, 50 kg Zn ha^{-1} (M_3) the recorded highest value of 26 pods per plant as compared to control (M_1) with 21 pods per plant. But it was on par with 25 kg Zn ha^{-1} (M_2) which recorded 24 pods per plant. Similar findings were reported by Chaudhary *et al*. (2014), Usman *et al*. (2014) and Upadhyay and Singh. (2016).

Among blackgram varieties, the highest value of 25.2 pods per plant was recorded by PU 31 (S_5) with LBG 752 (S_1) which was on par with LBG 752 (S_1- 24 pods per plant) and TBG 104 (S_3– 24 pods per plant). Whereas, least value 22 pods per plant was noted with GBG 1 (S_4) harvest stages of crop. However, the interaction effect between main and sub plot treatments had found non-significant.

Seed Yield (kg ha^{-1})

From the data furnished in table 4 were inferred that seed yield of blackgram was significantly affected by Zn levels and blackgram varieties.Treatment M_3(50 kg Zn ha^{-1}) had recorded significantly higher seed yield (997 kg ha^{-1}) as compared to M_1(control) (795 kg ha^{-1}) but it was on par with M_2 (25 kg ha^{-1}) (968 kg ha^{-1}). The percent increase of seed yield of M_3 and M_2 over M_0 was 25 and 22 , respectively. Increase in seed yield might be due to the enhancement of pod formation and subsequent increase in the number of seeds per pod and also due to enhanced synthesis of carbohydrates and their transportation to reproductive parts (Peddababu *et al*. 2007). Similar results were reported by Khan *et al*. (2007), Gajbhiye*et al*. (2018) and Kumar *et al*. (2022).

Among sub plot treatments, significantly higher seed yield was registered by the variety PU 31 (S_5 - 988 kg ha^{-1}), which was on par with LBG 752 (S_1 - 961 kg ha^{-1}) and TBG 104 (S_3 - 926 kg ha^{-1}) but significantly superior over the rest of the varieties. Significantly lowest value of seed yield was noted with treatment S_4 (GBG 1). Whereas, the interaction effect of zinc levels and blackgram varieties was found non-significant.

Haulm Yield (kg ha^{-1})

Data presented in table 5 relating to haulm yield of blackgram at harvest stage as influenced by different levels of Zn application and blackgram varieties, showed M_3 treatment *i.e.,* 50 kg Zn ha^{-1} that recorded significantly higher haulm yield (2170 kg ha^{-1}) over control (M_1 - 1995 kg ha^{-1}). However, it was on par with M_2 (25 kg Zn ha^{-1}) (2127 kg ha^{-1}). The per cent increase of haulm yield of M_3 and M_2 over M_0 was 8.7 and 6.6 respectively. Zinc application resulted in early growth of seedling and superior nutrition which leads to enhanced dry matter production ultimately increased haulm yield of crop. Similar results were reported by Tabassum *et al*. (2014), Chaudary and Sinha (2007) and Jat *et al*. (2021).

Among sub plot treatments, significantly higher haulm production was recorded by the variety LBG 752 (S_1- 2230 kg ha^{-1}) which was on par with LBG 787 (S_2- 2144kg ha^{-1}) and PU 31 (S_5–2098kg ha^{-1}) and it was significantly superior over rest of varieties. While the lowest value of haulm yield was recorded with the variety GBG 1 (S_4-2001 kg ha^{-1}). Whereas, the interaction of Zn levels and blackgram varieties on haulm yield of backgram was found non-significant.

Harvest Index

The data pertaining to harvest index of blackgram given in the table 6. indicated that harvest index of blackgram crop significantly increased with increased levels of zinc application. Among main plots treatments, harvest index ranged from 28.6 to 31.5%. Highest harvest index value of 31.5 % was noted in treatment M_3 (50 kg Zn ha^{-1}) which was on par with M_2 (25 kg Zn ha^{-1}) (31.2 %) and significantly superior over M_1 (control) (28.6 %).This could be due to role of Zn in initiation of primordial for reproductive parts and biosynthesis of IAA and also might be due to favorable effect of zinc on metabolic reaction of plant. Similar increase a trend was reported by Usman *et al*. (2014) in greengram.

There was no significant difference among varieties with respect to harvest index. However, numerically highest harvest index (31.9 %) was recorded in PU 31 (S_5) and lowest (29.0 %) in LBG 787 (S_2). Similarly, interaction effect between Zn levels and blackgram varieties on harvest index was found statistically non-significant.

All growth, yield attributes and yield parameters were significantly affected by both zinc levels and blackgram varieties. Values of all parameters were increased with increased levels of zinc application from 0 to 50 kg Zn ha^{-1}. Irrespective of parameters, significantly higher values were recorded with the application of Zn @ 50 kg Zn ha^{-1} over control but it was statistically on par with 25 kg Zn ha^{-1} at all stages of observation. Similarly, among varieties of blackgram, PU 31 had recoded higher values of all parameters except dry matter production. From the results of present investigation, combination of PU 31 blackgram variety with Zn application @ 25 kg ha^{-1} was found to be economical when farmers field containing medium range native soil zinc.

LETERATURE CITED

Arshewar S P, Karnjikar P N, Damble A S and Kawde M B 2018. Effect of nitrogen and zinc levels on growth, yield and economics of pearl millet (*Pennisetum glaucum* L.). *International Journal of Bio-resource and Stress Management*. 9(6): 729-732.

Chaudary S K and Sinha N K 2007. Effect of Levels of Nitrogen and Zinc Application on Grain Yield and their Uptake in Transplanted Rice. *Oryza*. 44(1): 44-47.

Table 1. Effect of rate of zinc applivation and blackgram varieties on plant height of blackgram

Zn levels (kg ha^{-1})	Plant height (cm)											
	Pod development stage						Harvest stage					
	Blackgram varieties					Mean M	Blackgram varieties					Mean M
	S_1	S_2	S_3	S_4	S_5		S_1	S_2	S_3	S_4	S_5	
M_1	37.0	35.5	30.0	31.4	33.7	**33.5**	39.1	37.8	33.6	32.2	36.3	**35.8**
M_2	39.9	38.2	34.2	33.3	36.3	**36.4**	43.6	41.5	37.6	37.0	39.2	**39.8**
M_3	42.9	41.6	38.3	35.8	36.6	**39.0**	46.6	45.9	38.9	37.8	40.0	**41.8**
Mean S	**39.9**	**38.4**	**34.1**	**33.5**	**35.5**		**43.1**	**41.7**	**36.7**	**35.6**	**38.5**	
	SEm±		**CD (p=0.05)**			**CV (%)**	**SEm±**		**CD (p=0.05)**			**CV (%)**
M	0.73		2.90			7.87	0.69		2.73			6.87
S	0.92		2.71			7.66	1.04		3.04			7.98
M X S	1.61		NS				1.81		NS			
S X M	1.62		NS				1.76		NS			

Table 2. Effect of rate of zinc application and blackgram varieties on dry matter production in soil at different growth stages of blackgram

Zn levels (kg ha^{-1})	Dry matter production (kg ha^{-1})											
	Pod development stage						Harvest stage					
	Blackgram varieties					Mean M	Blackgram varieties					Mean M
	S_1	S_2	S_3	S_4	S_5		S_1	S_2	S_3	S_4	S_5	
M_1	1614	1591	1485	1516	1523	**1546**	3851	3694	3466	3216	3627	**3570**
M_2	1836	1820	1738	1750	1760	**1781**	4867	4760	4579	4354	4644	**4641**
M_3	1901	1887	1806	1614	1838	**1809**	5028	4936	4835	4756	4900	**4891**
Mean S	**1783**	**1766**	**1676**	**1627**	**1707**		**4582**	**4463**	**4293**	**4108**	**4390**	
	SEm±		**CD (p=0.05)**			**CV (%)**	**SEm±**		**CD (p=0.05)**			**CV (%)**
M	29.4		115			6.66	90.8		356			8.05
S	35.7		104			6.26	96.3		281			6.61
M X S	61.9		NS				166		NS			
S X M	62.0		NS				174		NS			

Table 3. Effect of rate of zinc application and blackgram varieties on number of pods per plant in blackgram

Zn levels (kg ha^{-1})	Number of pods per plant					
	Blackgram varieties					Mean M
	S_1	S_2	S_3	S_4	S_5	
M_1	21.6	20.3	21.3	20.5	22.5	**21.2**
M_2	25.1	23.5	25.1	23.2	25.5	**24.5**
M_3	27.0	25.3	26.4	24.8	27.5	**26.2**
Mean S	**24.6**	**23.1**	**24.3**	**22.8**	**25.2**	
	SEm±		**CD (p=0.05)**			**CV (%)**
M	0.48		1.89			7.79
S	0.51		1.50			6.44
M X S	0.89					
S X M	0.93					

Table4. Effect of rate of zinc application and blackgram varieties on seed yield in blackgram

Zn levels (kg ha^{-1})	Seed yield (kg ha^{-1})					
	Blackgram varieties					Mean M
	S_1	S_2	S_3	S_4	S_5	
M_1	829	756	819	720	852	**795**
M_2	1009	938	933	933	1026	**968**
M_3	1043	937	1026	894	1086	**997**
Mean S	**961**	**877**	**926**	**849**	**988**	
	SEm±		CD (p=0.05)			CV (%)
M	15.1		59.3			6.35
S	23.0		67.3			7.51
M X S	39.9		NS			
S X M	38.7		NS			

Table 5. Effect of rate of zinc application and blackgram varieties on haulm yield (kg ha^{-1}) in blackgram

Zn levels (kg ha^{-1})	Haulm yield (kg ha^{-1})					
	Blackgram varieties					Mean M
	S_1	S_2	S_3	S_4	S_5	
M_1	2108	2045	1904	1893	2026	**1995**
M_2	2185	2193	2067	2055	2135	**2127**
M_3	2398	2193	2067	2056	2135	**2170**
Mean S	**2230**	**2144**	**2012**	**2001**	**2098**	
	SEm±		CD (p=0.05)			CV (%)
M	33.8		133			6.25
S	57.1		166			8.17
M X S	98.9		NS			
S X M	94.7		NS			

Table 6. Effect of rate of zinc application and blackgram varieties on harvest index (%) in blackgram

Zn levels (kg ha^{-1})	Harvest index (%)					
	Blackgram varieties					Mean M
	S_1	S_2	S_3	S_4	S_5	
M_1	28.4	27.1	30.0	27.7	29.7	**28.6**
M_2	31.6	29.9	31.0	31.2	32.4	**31.2**
M_3	30.5	29.9	33.1	30.2	33.7	**31.5**
Mean S	**30.2**	**29.0**	**31.4**	**29.7**	**31.9**	
	SEm±		CD (p=0.05)			CV (%)
M	0.54		2.14			6.94
S	0.89		NS			8.77
M X S	1.54		NS			
S X M	1.48		NS			

Chaudhary S, Harvendra S, Sandeep S and Vinay S 2014. Zinc Requirement of Greengram (*Vigna radiata*) - Wheat (*Triticum aestivum*) Crop Sequence in Alluvial Soil. *Indian Journal of Agronomy.* 59(1): 48-52.

Gajbhiye P N, Bulbule A V and Kumbhar C T 2018. Effect of Zinc Fertilizer Levels and Application Methods on Zinc Fractions and Grain Yield of Maize. *International Journal of Current Microbiology and Applied Sciences.*7(11): 1-12.

Jat G, Sharma S K, Meena R H, Jain D, Chaoudhary R, Chaoudhary R S and Yadav S K 2021. Amelioration of Zinc Deficiency in Blackgram (*Vigna mungo* L.) through Soil Applied Zinc in Typic Hapliustepts Soil of Rajasthan. *Journal of Enironmental Biology*. 42(6): 1554-1559.

Khan R, Gunnani A, Klhan M and Gurmani A (2007). Effect of Zinc Application on Rice Yield under Wheat Rice Cropping System. *Pakistan Journal of Biological Sciences* 10: 235-239.

Kumar S, Verma G, Dhaliwal S S and Sharma V 2022. Influence of Zinc Fertilization Levels and Frequencies on Crop Productivity, Zinc Uptake and Buildup of Soil Zinc in Maize-Wheat System. *Journal of Plant Nutrition*. 45(12): 1774-1785.

Mohsin A U, Ahmad A U H, Farooq M, Ullah S 2014. Influence of zinc application through seed treatment and foliar spray on growth, productivity and grain quality of hybrid maize. *The Journal of Animal &Plant Sciences.* 24(5): 1494-1503.

Panse V G and Sukhatme P V 1978. Statistical Methods for Agricultural Workers. *Indian Council of Agricultural Research*. New Delhi. 199.

Peddababu P, Shanthi M, Prasad B R and Minhas P S 2007. Effect of Zinc in Rice-Blackgram Cropping System in Saline Soils. *The Andhra Agricultural Journal*. 54 (1-2): 47-50.

Samreen T, Humaira, Shah H U, Ullah S and Javid M 2013. Zinc Effect on Growth Rate, Chlorophyll, Protein and Mineral Contents of Hydroponically Grown Mungbeans Plant (*Vigna radiata*). *Arabian Journal of Chemistry*. 10: S1802-S1807.

Shakoor K, Abdul A P K, Feroz B and Tamana K 2018. Growth, Yield and Post-Harvest Soil Available Nutrients in Sweet Corn (*Zea mays* L.) as Influenced by Zinc and Iron Nutrition. *Journal of Pharmacognosy and Phytochemistry*. 7(4): 2372-2374.

Sharma, V and Abraham, T. 2010. Response of Blackgram (*Phaseolus mungo*) to Nitrogen, Zinc and Farmyard Manure. *Agricultural Research Communication Centre.* 33 (4): 295-298.

Singh B, Natesan S K A, Singh B K and Usha K 2005. Improving zinc efficiency of cereals under zinc deficiency. Current Science. 88(1-10): 36-44.

Sitaram T, Sharma S K and Reager M L 2013. Growth Attributes and Nutrient Uptake of Greengram as Influenced by Vermicompost and Zinc in Arid Western Rajasthan. *Advance Research Journal of Crop Improvement*. 2(1): 65-69.

Slaton N A, Gbur E E, Wilson C E and Norman R J 2005. Rice response to granual zinc sources varying in water soluble zinc. *Soil Science Society of American Journal*. 69: 443-452.

Tabassum S, Jeet S, Kumar R, Dev C M , Kumar P and Rehana 2014. Effect of Organic Manure and Zinc Fertilization on Zinc Transformation and Biofortification of Crops in Vertisols of Central India. *Journal of Agricultural Science*. 6(8): 2014.

Upadhyay R G and Singh A 2016. Effect of Nitrogen and Zinc on Nodulation, Growth and Yield of Cowpea (*Vigna unguiculata*). *Legume Research*,39(1): 146-151.

Usman M, Tahir M and Majeed M A 2014. Effect of Zinc Sulphate as Soil Application and Seed Treatment on Green Gram (*Vigna radiate* L.). *Pakistan Journal of Life and Social Science*. 12(2): 87-91.

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