



Effect of Sulphur and Zinc on Growth and Yield of Black Gram (*Phaseolus mungo* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted during *Zaid* (summer) season of 2023 at Crop Research Farm, Department of Agronomy. The treatments consisted of 3 levels of Sulphur (10, 20 and 30 kg/ha) and 3 levels of zinc (10kg/ha, 0.1% and 0.2% foliar application) and a control. The experiment was laid out in Randomized Block Design (RBD) with 10 treatment and replicated thrice. Application of Sulphur (30 kg/ha) + Zinc (10kg/ha) (treatment 9) recorded higher Plant height, higher plant dry weight, higher number of Pods/Plant, higher number of seeds/pod, higher test weight and higher seed yield. The (treatment 9) also recorded Maximum benefit cost ratio (2.41)

Keywords: Black gram; sulphur; zinc; growth; yield and economics.

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1. INTRODUCTION

“Black gram (*Phaseolus mungo* L.) is one of the important pulse crop. The food legumes, particularly the grain or pulses are important food stuff in all tropical and subtropical countries. It is also known as urd bean, urad dal or urad. Black gram is grown well in moisture retentive light soil, but loamy and clay loam are suitable for the cultivation of Black gram. Loam to clay loam with neutral pH are best suited for Black gram cultivation. It is susceptible to waterlogged conditions of the soil. It is popular because of its nutritional quality having rich protein (22.24%), carbohydrates (56.6-59.6%), fat (1.2-1.4%), Minerals (3.2%), phosphorous (385 mg/100g) and it is rich source of calcium and iron. It differs from other pulses in its peculiarity of attaining a somewhat mucilaginous pasty character, giving additional body to the mass due to long polymer chain of polysaccharide chain of carbohydrates. Due to cheaper protein source, it is designated as poor man's meat” [1]. “About 70% of the world's black gram production comes from India. India is the world's largest producer as well as consumer of black gram. It produces about 11.99 million tonnes of Urad annually from about 9.85 million hectares of area, Uttar Pradesh black gram production 0.84 million tonnes in an area about 0.61 million hectares” [2]. “Problems facing, crop's productivity is below average due to a number of limitations. In addition to inherent limitations, the country's low production of black gram is mostly caused by an imbalance in the supply and utilization of nutrients. Improved fertilization is necessary to increase black gram's output. It can symbiotically repair atmospheric nitrogen to suit its nitrogen needs. The nutrients phosphorus requires special consideration” [3]. “The growth and yield of black gram are influenced by various factors, among which nutrient availability plays a crucial role. Sulphur (S) and zinc (Zn) are essential nutrients that have been reported to have significant impacts on the growth and yield of various crops” [4]. “Sulphur application positively influenced the growth parameters of black gram, enhancing plant height, leaf area, and root development. Additionally, sulphur has been linked to improved nodulation and nitrogen fixation in leguminous crops, contributing to enhanced yield” [5].

2. MATERIALS AND METHODS

This experiment was laid out during the *Zaid* season of 2023 at Crop Research Farm (CRF), Department of Agronomy, Naini Agricultural

Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). The crop research farm is situated at

25° 39' 42" N latitude, 81° 67' 56" E longitude and at an altitude of 98 m above mean sea level. The experiment was laid out in Randomized Block Design With ten treatments. Consisting of sulphur (10, 20 and 30 kg/ha) with foliar application of zinc (0.1 and 0.2 %) and soil application zinc at 10 kg/ha. The soil in the experimental area was sandy loam with pH (8.0), Organic Carbon (0.42%), available N (180.58 kg/ha), available P (15.54 kg/ha), and available K (198.67 kg/ha). Seeds are sown at a spacing of 30x10 cm² to a seed rate of 15 kg/ha. Bio fertilizer and Phosphorus were applied as per the treatments. Nitrogen, Phosphorus and Potash was applied as basal at the time of sowing. One hand weeding was done manually with *Khurpi* at 20 DAS followed by second manual weeding done at 40 DAS. This was done to control grass as well as broad leaf weeds. Two irrigation was applied to field. Data pertaining to various crop aspects such as growth and yield attributes underwent statistical analysis using the analysis of variance method [6], alongside economic data analyzed using mathematical methods.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

3.1.1 Plant height (cm)

At 45 DAS, significantly and higher plant height (24.98 cm) was recorded in treatment 9. However, treatment 7 (23.18 cm) were found to be statistically at par with treatment 9 (24.98cm).

The significant and higher plant height recorded with application of Sulphur (35kg/ha) due to involvement of sulphur in stimulation of cell division, photosynthetic process as well as formation of chlorophyll [7]. Furthermore, the addition of zinc (10 kg/ha) may have improved soil nitrogen absorption and tissue cell division variance. Similar result was found by Singh et al. [8].

3.1.2 Plant dry weight

At 45 DAS, significant and maximum plant dry weight (8.71 g) was recorded in treatment 9. However, treatment 7 (7.62 g) and treatment 8 (7.45 g), were found to be statistically at par with treatment 9 (8.71 g).

Table 1. Effect of Sulphur and Zinc on growth and yield of Black gram

S.No.	Treatment Combinations	Plant height (cm) at 45 DAS	Dry weight at 45 DAS (g/plant)	Crop growth rate 30-45 DAS (g/m ² /day)	Number of pods/plant	Number of seeds/pod	Test weight (g)	Seed Yield (kg/ha)	Benefit Cost ratio
1	Sulphur 10 kg / ha + Zinc 0.2 %	18.96	4.65	4.71	28.50	4.43	32.77	909.51	1.20
2	Sulphur 10 kg / ha + Zinc 0.1 %	18.24	4.38	4.49	26.58	4.23	31.75	904.31	1.19
3	Sulphur 10 kg / ha + Zinc 10 kg / ha	19.25	4.85	4.80	31.08	5.17	33.01	947.41	1.22
4	Sulphur 20 kg / ha + Zinc 0.2 %	21.39	6.55	7.18	32.67	5.70	34.01	1000.81	1.41
5	Sulphur 20 kg / ha + Zinc 0.1 %	20.50	5.81	6.14	31.25	5.50	33.06	988.81	1.36
6	Sulphur 20 kg / ha + Zinc 10 kg / ha	22.12	6.80	7.03	34.67	6.17	35.44	1054.69	1.47
7	Sulphur 30 kg / ha + Zinc 0.2 %	23.18	7.62	7.79	37.18	6.42	36.89	1249.64	1.98
8	Sulphur 30 kg / ha + Zinc 0.1 %	22.70	7.45	7.40	36.17	6.27	36.39	1229.45	1.93
9	Sulphur 30 kg / ha + Zinc 10 kg / ha	24.98	8.71	8.84	38.67	6.93	37.44	1504.55	2.41
10	N-P-K 20:40:20 kg/ha (control)	17.93	4.15	4.15	26.09	4.06	31.41	889.51	1.18
	SEm(±)	0.62	0.43	0.61	1.04	0.11	1.02	62.47	-
	CD (p=0.05)	1.84	1.27	1.81	3.09	0.32	3.02	281.30	-

The significant and higher plant dry weight (g) was observed with the application of the significant and higher plant dry weight with the application of sulphur (30kg/ha) this is due to the continuous and slow release of nutrients [7]. Further increase in dry weight observed with the application of zinc (20kg/ha) might be due to Zinc application which created a balanced nutritional environment to enhanced metabolic activities and photosynthetic rate, resulting in improvement and ultimately accumulation of plant dry matter. Similar types of results were reported by Meena et al. [9].

3.1.3 Crop growth rate (g/m² /day)

At 30–45 DAS, significant and maximum crop growth rate (8.84 g/m² /day) was recorded with treatment 9. However, treatment 4 (7.18 g/m²/day), 6 (7.03 g/m²/day) 7 (7.79 g/m²/day) and treatment 8 (7.40 g/m²/day), were found to be statistically at par with treatment 9.

3.2 Yield and Yield Attributes

3.2.1 Number of pods/plant

The data pertaining to number of pods/plants affected by different, Treatment 9 (38.67) significant and maximum number of pods/ plant which was superior over all other treatments. However, treatment 7 (37.18) and treatment 8 (36.17) was found to be statistically at par with the treatment 9 (38.67).

The significant and higher number of pods/plant was with the application of sulphur (30kg/ha) might be due to the tissue differentiation from somatic to reproductive meristematic activity and development of floral primordial might have increased with increasing in more flowers and pods Morteza et al. (2018). Further Significant and higher number of pods/plants was with the application of might be because zinc (10kg/ha) might be due increase levels of Zn application to crops on nutrient metabolism, biological activity and growth parameters and hence which applied zinc results in taller and higher enzyme activity in pods/ plant. Similar results were reported by Yashona et al. [10].

3.2.2 Number of seeds/pod

Treatment 9 (6.93) was recorded significant and maximum number of seeds/pod which was superior over all other treatments. However,

treatment 7 (6.42) was found to be statistically at par with the treatment 9 (6.93).

Further Significant and higher number of seed/pod was observed with the application of Zn application of appropriate fertilisers increased assimilate production and photosynthesis efficiency of the seed filling. Similar types of results were reported by Yashona et al. [10].

3.2.3 Seed Yield (kg/ha)

Treatment 9 (1504.55kg/ha) was recorded significantly maximum Seed yield which was superior over all other treatments. However, the treatment 7 (1249.64kg/ha) and treatment-8 (1229.45kg/ha) was found to be statistically at par with the treatment 9 (1504.55 kg/ha).

“The significant and higher seed yield observed with the application of sulphur (45 kg/ha) might be due to sulphur enhancing plant metabolism and photosynthetic activity. Similar results have been observed” [11].

3.2.4 Benefit cost ratio

Benefit cost ratio (2.41) was found to be highest in treatment 9 [Sulphur (30kg/ha) + Zinc (10kg/ha)] and minimum benefit cost ratio (1.18) was found to be in treatment 10 (Control) as compared to other treatments.

Higher gross returns, net returns, benefit cost ratio recorded with application of zinc (20kg/ha) might be due to maximum recovery from application of zinc with less expenditure and higher seed yield and strow yield obtained from these treatments. These results are in conformity with those observed by Sunil et al. [12].

4. CONCLUSION

It is concluded that the application of Sulphur 30 kg/ha along with Zinc 10 kg/ha in (treatment 9) was recorded higher plant height, maximum plant dry weight, and yield attributes namely more number of pods/plants, seed/pod, test weight, highest seed yield and maximum benefit cost ratio.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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