Original Research Article

Effect of Sulphur and Zinc on Growth and Yield of black gram *(Phaseolus mungo* L.*)*

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 gross return (INR 98297.69 /ha), net return (INR 64701.09/ha) and benefit cost ratio (2.41)

***Key* words:** Black gram, sulphur, zinc, Growth, Yield and Economics.

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 (2224%), 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 defers 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" **(Aslam *et al.*, 2010).** 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. (**GOI, 2021-22**). 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 **(Singh *et al.*, 2020).** 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. (**Sharma *et al.*, 2018)** demonstrated that 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. (**Bhattacharjee *et al.***
2013)

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 25^0 39" 42" N latitude, 81^0 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 30×10 cm^2 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 was done at 40 DAS. This was done to control grass as well as broad leaf weeds.Two irrigation was applied to field.Data recorded on different aspects of crop, *viz.,* growth, yield attributes were subjected to statistically analysis by analysis of variance method. (**Gomez and Gomez, 1976)** and economic data analysis mathematical method.

RESULT AND DISCUSSION:

Growth parameters 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 was with application of Sulphur (35kg/ha) might be due to involvement of sulphur in stimulation of cell division, photosynthetic process as well as formation of chlorophyll (**Arunraj *et al*. 2018)**. Further, the application of Zinc (10kg/ha) this might be due to enhances the differentiation of tissue cell division and nitrogen absorption from the soil. Similar result was found by **Singh *et al*. (2014).**

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).

The significant and higher plant dry weight (g) was observed with the application of The significant and higher plant dry weight was with the application of sulphur (30kg/ha)might be due to the continuous and slow release of nutrients (**Arunraj *et al*. 2018).**Further increase in dry weight observed with the application of zinc (20kg/ha) might be due to Zinc applicationcreated a balanced nutritional environment which 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.* (2006).**

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.

Yield and Yield attributes

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, the 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.* (2018).**

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, the 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 approprite fertilisers increased assimilate production and photosynthesis efficiency of the seed filling. Similar types of results were reported by **Yashona *et al.* (2018).**

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 haulm yield was observed with the application of Sulphur (45 kg/ha) might be due to sulphur enhances the plant metabolism and photosynthetic activity. Similar results have been. Results were similar to **Jet *et al*. (2021)**.

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 was 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 treatment. These results are in conformity with those observed by **Sunil *et al.* (2017).**

CONCLUSION:

It is concluded that the application of Sulphur 30 kg/ha along with Zinc 10 kg/ha in (treatment9) was recorded Higher plant height, more number of branches/plant. More nodules/plant, maximum plant dry weight, and yield attributes namely more number of pods/plants, seed/pod, highest seed yield and stover yield Maximum gross return, net return and benefit cost ratio.

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

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
Sulphur 10 kg / ha + Zinc 0.2 %	18.96	4.65	4.71	28.50	4.43	32.77	909.51	1.20
Sulphur 10 kg / ha + Zinc 0.1 %	18.24	4.38	4.49	26.58	4.23	31.75	904.31	1.19
Sulphur 10 kg / ha + Zinc 10 kg / ha	19.25	4.85	4.80	31.08	5.17	33.01	947.41	1.22
Sulphur 20 kg / ha + Zinc 0.2 %	21.39	6.55	7.18	32.67	5.70	34.01	1000.81	1.41
Sulphur 20 kg / ha + Zinc 0.1 %	20.50	5.81	6.14	31.25	5.50	33.06	988.81	1.36
Sulphur 20 kg / ha + Zinc 10 kg / ha	22.12	6.80	7.03	34.67	6.17	35.44	1054.69	1.47
Sulphur 30 kg / ha + Zinc 0.2 %	23.18	7.62	7.79	37.18	6.42	36.89	1249.64	1.98
Sulphur 30 kg / ha + Zinc 0.1 %	22.70	7.45	7.40	36.17	6.27	36.39	1229.45	1.93
Sulphur 30 kg / ha + Zinc 10 kg / ha	24.98	8.71	8.84	38.67	6.93	37.44	1504.55	2.41
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	-

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