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Influence of Phosphorus and Foliar Application of Zinc on Growth and Yield of Summer Blackgram (*Vigna mungo* L.)

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ABSTRACT

The field study was carried out between *Zaid* 2022 and the Farm for Crop Research, Department of Agronomy, Prayagraj's SHUATS is home to the Naini Agricultural Institute (UP) India. To study the Response of phosphorus and foliar application of zinc on growth and yield of blackgram. The factors consist of phosphorus at 30 kg/ha, 40 kg/ha, 50 kg/ha respectively foliar application of zinc at 0.1% at 20 DAS, 0.3% at 30 DAS, 0.5% at 40 DAS. Nine treatments were used, and each was repeated three times. The experimental plot's soil had a loamy sand texture and had a nearly neutral soil reaction. (pH 7.8), low in organic carbon (0.35%) accessible N (163.42 kg/ha), accessible P (21.96 kg/ha), and accessible K (256.48 kg/ha). Results revealed that the higher plant height (40.02 cm), higher number of root nodules per plant (24.00), higher number of branches per plant (6.66) higher plant dry weight (8.03 g/plant), higher number of pods per plant (20.00), higher number of seeds per pod (6.11), higher test weight (34.07 g), higher seed yield (1.39 t/ha), and higher stover yield (2.04 t/ha) were significantly influenced with the application of phosphorus 50 kg/ha along with zinc 0.5% at 40 DAS. Higher gross return (INR 111930.23/ha), higher net return (INR 80415.73/ha) and higher B:C ratio (2.55) were also recorded with the application of phosphorus 50 kg/ha along with zinc 0.5% at 40 DAS.

Keywords Blackgram, Phosphorus, Zinc, Growth parameters, Yield, Economics.

INTRODUCTION

Blackgram (*Vigna mungo* L.) also known as urd-bean, urd and urad, is an important pulse crop grown throughout India. India has become self-sufficient with respect to production of cereals but still lags behind with respect to the production of pulses, even though it is the biggest manufacturer of pulses in the world. The split grains of the pulses, or dahl, are a fantastic source of high-quality protein, vital amino acids, fatty acids, fibre, minerals, and vitamins. Blackgram is one of the most highly valued pulses due to its high biological protein content and abundance in phosphoric acid. Among pluses, blackgram contributes 15.38 lakh ha of the total area and 2.84 million tonnes of the total production (Blackgram Outlook 2022).

According to some, phosphorus is the "Master

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Table 1. Influence of phosphorus and foliar application of zinc on growth attributes of blackgram.

Treatments	Plant height (cm)	Number of branches/ plant	Number of nodules/plant	Plant dry weight (g/plant)	Pods/ plant	Seeds/ pod	Test weight (g)	Seed yield (t/ha)	Stover yield (t/ha)	Harvest index (%)
T_1	37.77	6.00	21.00	5.48	17.55	4.66	30.64	0.84	1.49	36.54
T_2	37.35	5.77	21.67	5.35	17.66	5.00	30.92	0.91	1.67	35.30
T_3	36.81	6.00	22.33	6.00	18.33	5.33	31.14	1.01	1.77	36.37
T_4	37.74	6.00	23.67	6.50	18.22	5.22	31.93	1.01	1.72	37.12
T_5	38.05	5.78	18.33	7.19	19.78	5.55	31.68	1.16	1.72	40.29
T_6	39.60	6.33	22.33	7.97	19.89	5.89	33.38	1.30	1.96	39.97
T_7	37.52	5.88	20.33	7.19	19.33	5.55	31.67	1.13	1.67	40.36
T_8	36.15	5.00	16.00	7.33	19.66	5.66	32.53	1.21	1.81	40.00
T_9	40.02	6.66	24.00	8.03	20.00	6.11	34.07	1.39	2.04	40.47
Control	35.03	5.11	20.33	5.35	17.00	4.89	30.37	0.84	1.29	39.43
F test	S	S	S	S	S	S	NS	S	S	NS
SEm (±)	0.56	0.18	0.75	0.23	0.18	0.18	0.77	0.05	0.07	1.81
CD (p =0.05)	1.69	0.53	2.25	0.69	0.55	0.55	2.29	0.15	0.23	5.40

key element" in crop productivity. Although it is the second-most important plant nutrient, pulses give it top priority because of its crucial function in root development and subsequent atmospheric nitrogen fixation. The application of phosphorus has a significant impact on the output and dietary value of pulses. It is essential for a number of physiological processes, including nitrogen fixation, nodulation, root development, creation of dry matter and protein synthesis (Kant *et al.* 2016).

The micronutrient zinc is the one that Indian soils are most deficient in. Zinc is regarded as the third most important limiting nutrient for agricultural productivity, behind nitrogen and phosphorus (Takkar and Randhawa 1980). The electron transfer mechanism, which drives photosynthesis, involves zinc during the reproductive stage (Baker *et al.* 1982). The connection between phosphorus and zinc has the largest potential impact among interactions between macro and micronutrients. High phosphorus levels inhibit the intake of zinc and, to a lesser extent, calcium so we are applying zinc applied topically to leaves.

MATERIALS AND METHODS

The field study was performed during *Zaid* 2022 at the Farm for Crop Research, Department of Agronomy, Prayagraj's SHUATS is home to the Naini Agricultural Institute (UP) India. Sandy loamy in texture, practically neutral in soil reactivity (pH 7.8), and low in organic carbon made up the experimental site's terrain plot. (0.35%), the treatments consist of phosphorus 30 kg/ha +Zinc 0.1% at 20 DAS, phosphorus 30 kg/ha +Zinc 0.3% at 30 DAS, phosphorus 30 kg/ha +Zinc 0.5% at 40 DAS, phosphorus 40 kg/ha +Zinc 0.1% at 20 DAS, phosphorus 40 kg/ha +Zinc 0.3% at 30 DAS, phosphorus 40 kg/ha +Zinc 0.5% at 40 DAS, phosphorus 50 kg/ha +Zinc 0.1% at 20 DAS, phosphorus 50 kg/ha +Zinc 0.3% at 30 DAS and phosphorus 50 kg/ha +Zinc 0.5% at 40 DAS, control. Ten treatments were reproduced three times, and the experiment was constructed using a random block layout. Analysis of variance was used in the statistical analysis of the acquired data (Gomez and Gomez 1976).

RESULTS AND DISCUSSION

Pre and post-harvest parameters

Plant height - At 60 DAS, the significantly higher plant height of (40.02 cm) Table 1 was recorded with treatment-9 (phosphorus 50 kg/ha + Zinc 0.5% at 40 DAS). However, treatment-6 phosphorus 40 kg/ha + Zinc 0.5% at 40 DAS (39.60 cm) was found to be

Table 2. Influence of phosphorus and foliar application of zinc on economics of blackgram.

Sl. No.	Treatments	Cost of cultivation	Gross return (INR/ha)	Net return (INR/ha)	B:C ratio
1	Phosphorus 30 kg/ha + Zinc 0.1% at 20 DAS	28,972.5	67,551.14	38,578.64	1.33
2	Phosphorus 30 kg/ha + Zinc 0.3% at 30 DAS	28,014.5	72,694.94	43,680.44	1.50
3	Phosphorus 30 kg/ha + Zinc 0.5% at 40 DAS	29,014.5	80,996.13	51,981.63	1.79
4	Phosphorus 40 kg/ha + Zinc 0.1% at 20 DAS	30,222.5	80,952.31	50,729.81	1.67
5	Phosphorus 40 kg/ha + Zinc 0.3% at 30 DAS	30,264.5	96,499.94	66,235.44	2.18
6	Phosphorus 40 kg/ha + Zinc 0.5% at 40 DAS	30,264.5	104,111.81	73,847.31	2.44
7	Phosphorus 50 kg/ha + Zinc 0.1% at 20 DAS	31,472.5	949,17.35	63,444.85	2.01
8	Phosphorus 50 kg/ha + Zinc 0.3% at 30 DAS	31,514.5	978,48.67	66,334.17	2.10
9	Phosphorus 50 kg/ha + Zinc 0.5% at 40 DAS	31,514.5	111930.23	80,415.73	2.55
10	Control (20:40:20 NPK kg/ha)	25,194.5	6426,9.39	39,074.89	1.55

statistically at par with treatment-9 (phosphorus 50 kg/ha + zinc 0.5% at 40 DAS). The plant height of blackgram increased significantly due to through the use of phosphorus it enhanced the level of nutrient availability, leading to the removal of grater, which may have promoted photosynthesis and moved synthase to other areas to encourage meristematic development in possible apical buds and intercalary meristems, increasing the crop's growth characteristics. The superior nourishment and use of the plants in the well-fertilized plots may be the cause of the rise in plant growth similar results are conformity with Parashar *et al.* (2020). Along with the application zinc also significantly involved in increasing the plant height zinc's impact on developing plants' metabolism may be what causes the observed reaction to zinc application, as seen by the growth in plant height under zinc treatment, and observed that zinc spraying had a favorable effect on plant height Shanti *et al.* (2008).

Number of branches/plant - At 60 DAS, the significantly higher number of branches/plant (6.66) Table 1 were recorded with treatment-9 (Phosphorus 50 kg/ha + Zinc 0.5% at 40 DAS). However, treatment 6 Phosphorus 40 kg/ha + Zinc 0.5% at 40 DAS (6.33) was found to be statistically at par with treatment-9 (Phosphorus 50 kg/ha + Zinc 0.5% at 40 DAS). The significantly higher number of branches/plant were recorded with the application of phosphorus 50 kg/ha. This might be due to phosphorus, being the constituent of nucleic acid and different forms of proteins, might have stimulated cell division resulting in increased growth of plants similar results reported by (Niraj and Prakash 2014) and also zinc is used in the application results in significantly enhanced the main cause of branching in pulses was auxin-induced stimulation of bud and branch formation, while Zn treatment ultimately enhanced the availability of other nutrients and accelerated the translocation of photo assimilates (Krishna *et al.* 2022).

Number of nodules/plant – At 60 DAS, the significantly higher number of nodules/plant (24.00) Table 1 were recorded with treatment-9 (Phosphorus 50 kg/ha + Zinc 0.5% at 40 DAS). However, treatment-6 phosphorus 40 kg/ha + Zinc 0.5% at 40 DAS (22.33) was found to be statistically at par with treatment-9 (phosphorus 50 kg/ha + zinc 0.5% at 40 DAS). Significantly higher nodules per plant, number observed after applying 50 kg/ha of phosphorus, this could be because phosphorous stimulates the symbiotic nitrogen fixation of bacterial cell to root hair for nodulation. Phosphorous helps in proper root development which increases root nodules and consequently increases nitrogen fixation (Charel 2006)

Plant dry weight –At 60 DAS, the significantly higher plant dry weight (8.03 g) (Table 1) was recorded with treatment-9 (Phosphorus 50 kg/ha + Zinc 0.5% at 40 DAS). However, treatment-6 phosphorus 40 kg/ha + Zinc 0.5% at 40 DAS (7.97) was found to be statistically at par with treatment-9 (Phosphorus 50 kg/ha + Zinc 0.5% at 40 DAS). with the application of Phosphorus recorded the significant enhancement of dry weight this could be as a result of the beneficial effects of phosphorus on growth that phosphorus is chief constituent of the lipoids and nucleo proteins,

an abundance of phosphorus in the meristematic area may have aided in cell division and growth, as well as respiration, nitrogen fixation and carbohydrate transformation and hence boosted plant growth similar results conformity with (Parashar *et al.* 2020). And also, zinc is applied observed gradual increase in plant dry weight which is due to zinc aids in the production of chlorophyll, which may have led to better absorption and utilization of radiant energy and a rise in the rate of photosynthetic activity and finally increased dry matter production. Zinc application may have boosted photosynthetic efficiency, which may have resulted in an increase in dry matter production as measured by CGR similar results have been reported by Singh and Singh (2004).

Number of pod/plant – At harvest, the significantly higher number of pods/plant (20.00) (Table 1) were recorded with treatment-9 (phosphorus 50 kg/ha + zinc 0.5% at 40 DAS). However, treatment-6 phosphorus 40 kg/ha + Zinc 0.5% at 40 DAS (19.89) was discovered to be statistically comparable to treatment-9 (phosphorus 50 kg/ha + zinc 0.5% at 40 DAS). this might be due through the use of phosphorus, this might be explained by improved root growth, higher root development, increased nutrient availability and uptake and energy conversion and metabolic processes in plant and results in increasing the number of pods/plant similar results have been reported with Hussain *et al.* (2011) along with the application zinc also results in increasing the number pods per plant this may be due to zinc plays a very important role in the metabolism of the plant process by influencing the performance of growth enzymes as well as it is involved in carbohydrate metabolism, maintenance of the consistency of cell membranes, protein synthesis, and regulation of synthesis of auxin and development of pollen. The similar results were observed by Upadhyay and Singh (2016).

Number of seeds/pod – At harvest, the significantly higher number of seeds/pod (6.11) Table 1 were recorded with treatment-9 (phosphorus 50 kg/ha + zinc 0.5% at 40 DAS). However, treatment-6 phosphorus 40 kg/ha + zinc 0.5% at 40 DAS (5.89), was found to be statistically at par with treatment-9 (phosphorus 50 kg/ha + zinc 0.5% at 40 DAS). Maximum number of seeds per pod was observed with the application of phosphorus 50 kg/ha may be due to the increasing phosphorus fertilization in ensuring the availability of other plant nutrients which increased carbohydrate accumulation and their remobilization to reproductive parts of the plant , being the closest sink. Phosphorus is known to encourage flowering and fruiting which might have stimulated the plant to produce more pods per plant and enables development of a greater number of seeds per pod. Similar findings were reported by Shah *et al.* (2000).

Seed yield – At harvest, the significantly higher seed yield (1.39 t/ha) (Table 2) was recorded with treatment 9 (phosphorus 50 kg/ha + zinc 0.5% at 40 DAS). However, treatment-6 phosphorus 40 kg/ha + zinc 0.5% at 40 DAS (1.30) was found statistically comparable to treatment-9 (phosphorus 50 kg/ha + zinc 0.5% at 40 DAS). This may result from increasing the level of phosphorus application, the symbiotic nitrogen fixation power and in turn, increased number of pods/plant, number of grains/pod and 1000 grain weight and ultimately grain yield similar results confirmed with (Parashar *et al.* 2020). The increased in yield might be due to positive effect of zinc on yield attributes as it plays an important role in metabolic process (Shanti *et al.* 2008 and Ahmed *et al.* 2013).

Stover yield – At harvest, the significantly higher stover yield (2.04 t/ha) (Table 2) was recorded with treatment-9 (phosphorus 50 kg/ha + zinc 0.5% at 40 DAS). However, treatment 6 phosphorus 40 kg/ha + zinc 0.5% at 40 DAS (1.96) was found to be statistically at par with treatment-9 (phosphorus 50 kg/ha + zinc 0.5% at 40 DAS). Higher stover yield was observed with application phosphorus 50 kg/ha might be due to the increased growth and development in terms of plant height, branches and dry matter by improving nutritional environment of rhizosphere and plant system leading to higher plant metabolism and photosynthetic activity. Similar result was reported by (Yadav *et al.* 2017).

Economic analysis

Highest gross returns (1,11,930.23 INR/ha), Net returns (80,415.73 INR/ha), Benefit cost ratio (2.55) was observed in treatment-9 phosphorus is applied 50 kg/ha along with zinc 0.5% at 40 DAS.

CONCLUSION

It was concluded that with the application of phosphorus 50 kg/ha along with zinc 0.5% at 40 DAS (Treatment-9), has performs positively and improves factors for yield and growth. Maximum seed yield, gross returns, net return and benefit cost ratio were also recorded with the phosphorus is applied 50 kg/ha along with zinc 0.5% at 40 DAS (treatment-9). These findings are based on one season therefore, further trials may be require for further conformation .

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