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Effect of Different Levels of Phosphorus and Zinc on Growth and Yield of Green Gram (*Vigna radiata* L.) *Var.* Swati Swarna

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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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Original Research Article

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ABSTRACT

An experiment was conducted during in *Zaid* season (March 2022-June 2022) on central research farm of Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. The experiment was laid out in randomized block design with three levels of Phosphorus and Zinc (0 %, 50 % and 100 %). The treatment combinations were replicated three times and were allocated at random in each replication. The result shows that application of different levels combination of inorganic fertilizers increased growth, yield of green gram. It was recorded from the application of P and Zinc fertilizers in treatment T_7 [P @ 100% + Zinc @ 0%] maximum plant height 40.90, 49.12,

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and 60.16 cm at 30, 60 DAS and at harvest, number of branches plant^{-1} 9.35, 11.62, and 14.24 at 30, 60 DAS and at harvest, number of pods plant^{-1} 25.73, number of seeds pod^{-1} 10.54, test weight of 1000 seeds 54.66 g, grain yield 11.73 q ha^{-1} with benefit cost ratio 1: 2.33 best from T_1 [(control) P @ 0% + Zinc @ 0 %].

Keywords: Green gram; phosphorus; zinc; growth; yield.

1. INTRODUCTION

Green gram (*Vigna radiata* L.) having chromosome number 2n=24 is a self-pollinated legume crop. It is a native of India and Central Asia. It is the hardiest of all pulse crops. It can meet its nitrogen requirements by symbiotic fixation of atmospheric nitrogen. The nutrients which need attention are Phosphorus and Zinc (Handbook of Agriculture, ICAR -2002). It is also known as mung bean, is an important pulse crop grown in India. In India, production of green gram is around 2.32 million tonnes with an area of 3.49 million ha having productivity of 665 kg ha^{-1}.

"In Uttar Pradesh, Green gram is grown on 337 thousand ha with production of 2.47 million tonnes and the average productivity of 587 kg ha^{-1} (Ranpriya et al. 2017). Green gram is one of the important pulse crops containing about 23.9 % protein, 60% carbohydrate, 1.3% fat, 3.2% minerals, 0.9% fiber, 154 mg calcium, 385 mg Phosphorus, 9.1 mg iron and small amounts of vitamin B-complex. In recent years the importance of zinc in pulse nutrition has been well recognized" [1].

Phosphorus (P) is an essential nutrient for the development and proliferation of green plants. Several physiological processes, including photosynthesis, energy transfer, root development, and cell division, rely heavily on it. Phosphorus also contributes to the formation of DNA and RNA, which are essential for the growth and reproduction of plants. Phosphorus deficiency can cause stunted growth, weak root development, and decreased yield [2].

"Zinc is essential for the proper function of numerous enzyme systems, the synthesis of nucleic acids and auxins (plant hormones) metabolisms, protein analysis, and normal crop development and growth. This may be due to a delayed rate of Zn translocation from roots to tops, *i.e.*, zinc accumulation in the roots and decreased Zn uptake. Zn is absorbed by plants in the form of Zn. The most common symptoms of Zn deficiency in field cereals are poor growth, interveinal chlorosis, and necrosis of lower leaves" [3].

2. MATERIALS AND METHODS

A field experiment conducted at the Soil Science Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, during the *Zaid* season of 2022 growing green gram *Var*. Swati Swarna applied 3 levels of P and Zinc respectively 0 %, 50 %, 100 % and including RDF for black gram = 20:40:20 kg ha^{-1} and Zinc 20 kg ha^{-1} experiment is lead to observe the plant parameters like that plant height, number of branches plant^{-1}, number of pods plant^{-1}, number of seeds pod^{-1}, test weight of 1000 seeds and seed yield.

2.1 Statistical Analysis

The data recorded during the investigation was subjected to statistical analysis by RBD, as per the method "Analysis of Variance (ANOVA) technique" as given by Fisher [4]. "Experiment was laid out in RBD and the treatment will be replicated three times. The significant and non-significant effect was judged with the help of "F" (variance ratio) Table 1. The significant difference between the means were tested against the critical difference of 5% level. For testing the hypothesis in ANOVA Table 2 will be used" [3].

3. RESULTS AND DISCUSSION

3.1 Plant Height (cm)

A critical perusal of data pertaining in the Table 1 and Fig. 1 the effect of different levels of P and Zn on plant height (cm) at different days interval of green gram was found to be significant at C.D @ 5%. The plant height of green gram was found to be maximum 40.90, 49.12 and 60.16 cm at 30, 60 DAS and at harvest in treatment T_7 (P @ 100 % + Zn @ 0 %) and minimum 35.33, 42.44 and 51.10 cm at 30, 60 DAS and at harvest in treatment T_1 [Absolute control (P @ 0 % + Zn @ 0 %)]. Similar results were reported by Midde et al. [5] and Srivastava et al. [6].

3.2 Number of Branches Plant^{-1}

A critical perusal of data pertaining in the Table 1 and Fig. 1 the effect of different levels of P and Zn on number of branches plant^{-1} at different days interval of green gram was found to be significant at C.D @ 5%. The number of branches plant^{-1} of green gram was found to be maximum 9.35, 11.62 and 14.24 at 30, 60 DAS and at harvest in treatment T_7 (P @ 100% + Zn @ 0%) and minimum 7.37, 10.42 and 12.06 at 30, 60 DAS and at harvest in treatment T_1 Absolute control (P @ 0% + Zn @ 0%). Similar results were reported by Rathore et al. [7] and Masih et al. [8].

3.3 Number of Pods Plant^{-1}

A critical perusal of data pertaining in the Table 2 and Fig. 2 the effect of different levels of P and Zn on number of pods plant^{-1} at different days interval of green gram was found to be significant at C.D @ 5%. The number of pods plant^{-1} of green gram was found to be maximum 25.73 in treatment T_7 (P @ 100 % + Zn @ 0 %) and minimum 17.43 in treatment T_1 [Absolute control (P @ 0 % + Zn @ 0 %)]. Similar results were reported by Ranpariya et al. [9] and Rathore et al. [7].

3.4 Number of Seeds Pod^{-1}

A critical perusal of data pertaining in the Table 2 and Fig. 2 the effect of different levels of P and Zn on number of seeds pod^{-1} at different days interval of green gram was found to be significant at C.D @ 5%. The number of seeds pod^{-1} of green gram was found to be maximum 10.54 in treatment T_7 (P @ 100% + Zn @ 0%) and minimum 7.56 in treatment T_1 [Absolute control (P @ 0% + Zn @ 0%)]. Similar result has been recorded by Solanki et al. [10] and Ranpariya et al. [9].

3.5 Test weight of 1000 seeds (g)

A critical perusal of data pertaining in the Table 2 and Fig. 2 the effect of different levels of P and Zn on test weight of 1000 seeds of green gram was found to be significant at C.D @ 5%. The test weight of 1000 seeds of green gram were found to be maximum 54.65 g in treatment T_7 (P @ 100% + Zn @ 0 %) and minimum 51.34 g in treatment T_1 [Absolute control (P @ 0% + Zn @ 0%)]. Similar results were reported by Masih et al. [8] and Srivastava et al. [6].

3.6 Seed Yield (q ha^{-1})

A critical perusal of data pertaining in the Table 2 and Fig. 2 the effect of different levels of P and Zn on seed yield at different days interval of green gram was found to be significant at C.D @ 5% [11]. The seed yield of green gram was found to be maximum 11.73 q ha^{-1} in treatment T_7 (P @ 100% + Zn @ 0%) and minimum 8.01 q ha^{-1} in treatment T_1 [Absolute control (P @ 0% + Zn @ 0%)]. Similar results were reported by Roy et al. [12] and Barman et al. [13].

Table 1. Effect of different levels of P and Zn on plant height (cm) and number of branches plant^{-1} at different days interval of green gram

Treatment		Plant Height (cm)			Number of Branches Plant^{-1}		
		30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest
T_1	Absolute control (P @ 0 % + Zn @ 0 %)	35.33	42.44	51.10	7.37	10.42	12.06
T_2	@ 0 % P (RDF) + @ 50 % Zinc	35.57	42.90	53.15	7.63	10.65	12.35
T_3	@ 0 % P (RDF) + @ 100 % Zinc	36.10	43.57	53.90	7.85	10.81	12.60
T_4	@ 50 % P (RDF) + @ 0 % Zinc	36.18	44.10	55.50	8.03	10.92	12.90
T_5	@ 50 % P (RDF) + @ 50 % Zinc	37.23	44.92	55.87	8.42	11.04	13.18
T_6	@ 50 % P (RDF) + @ 100 % Zinc	37.57	45.33	57.12	8.74	11.15	13.42
T_7	@ 100 % P (RDF) + @ 0 % Zinc	40.90	49.12	66.16	9.35	11.62	14.24
T_8	@ 100 % P (RDF) + @ 50 % Zinc	39.42	47.33	58.15	9.22	11.45	14.08
T_9	@ 100 % P (RDF) + @ 100 % Zinc	38.90	45.12	57.16	9.00	11.21	14.00
	F-Test	S	S	S	S	S	S
	S.Ed. (±)	0.003	0.05	0.001	0.47	0.84	1.28
	C.D. at 0.5%	0.006	0.11	0.002	0.97	1.72	2.60

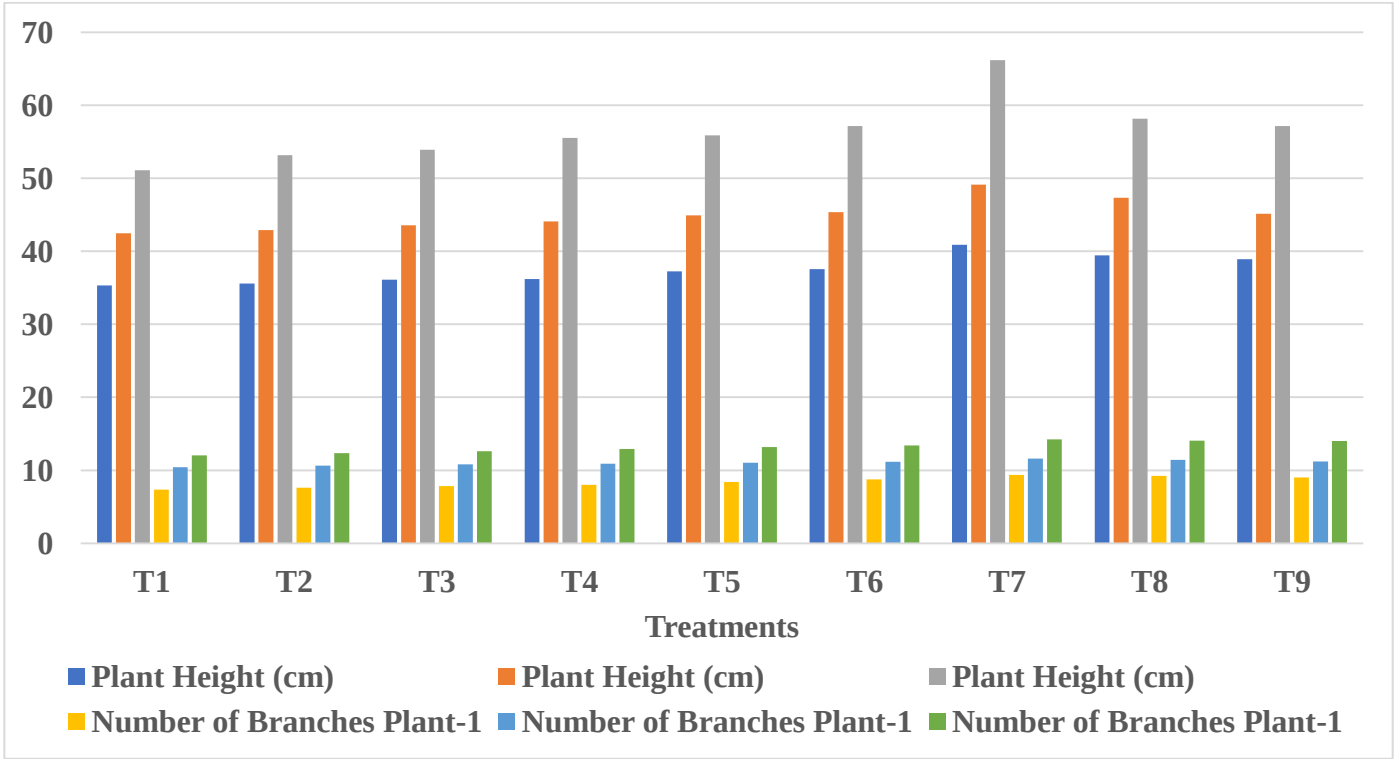

Fig. 1. Effect of different levels of P and Zn on plant height (cm) and number of branches plant^{-1} at different days interval of green gram

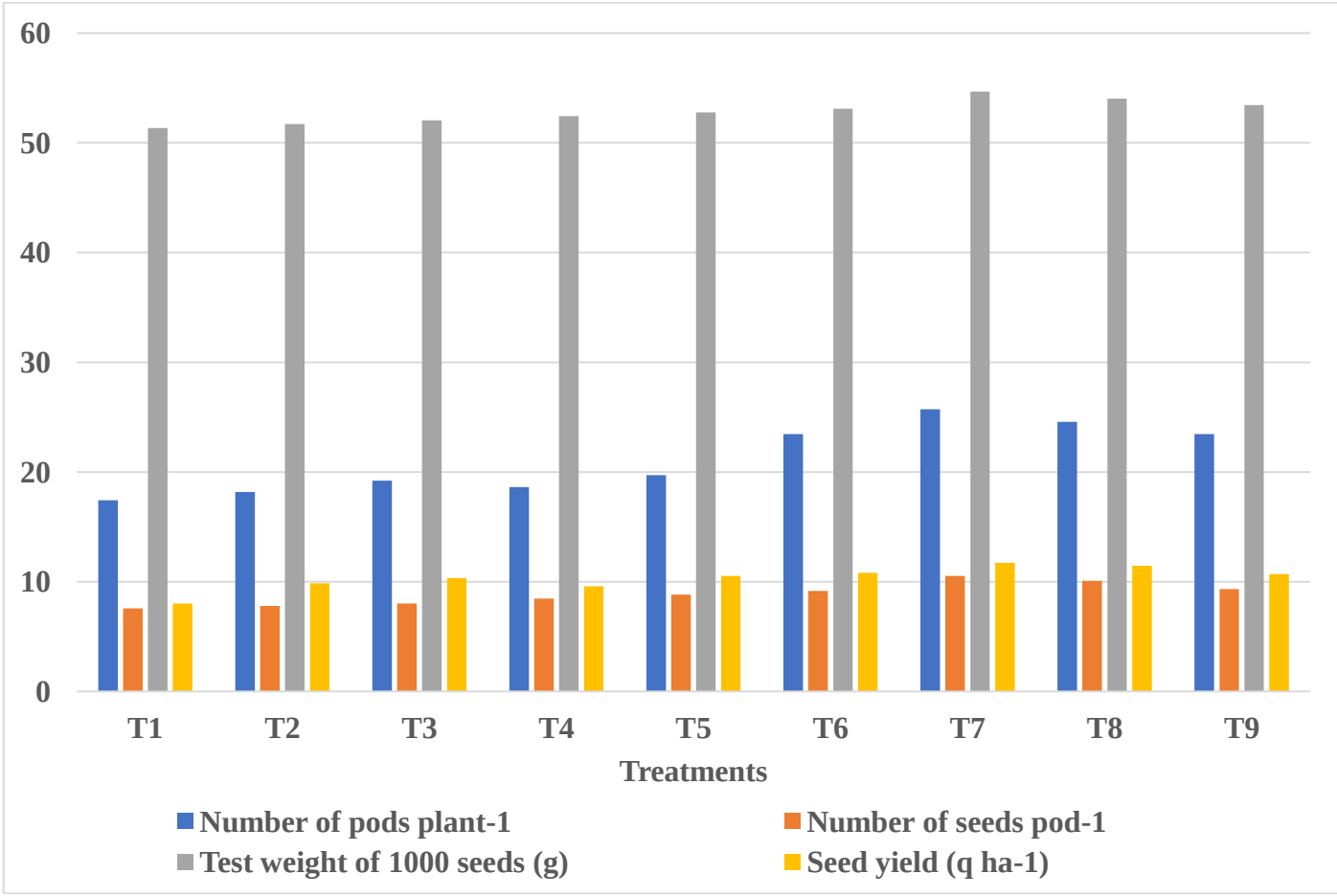

Fig. 2. Effect of different levels of P and Zn on number of pods plant^{-1}, number of seeds pod^{-1}, test weight of 1000 seeds (g) and seed yield (q ha^{-1}) of green gram

Table 2. Effect of different levels of P and Zn on number of pods plant^{-1}, number of seeds pod^{-1}, test weight of 1000 seeds (g) and seed yield (q ha^{-1}) of green gram

Treatment		Number of pods plant^{-1}	Number of seeds pod^{-1}	Test weight of 1000 seeds (g)	Seed yield (q ha^{-1})
T_1	Absolute control (P @ 0 % + Zn @ 0 %)	17.43	7.56	51.34	8.01
T_2	@ 0 % P (RDF) + @ 50 % Zinc	18.17	7.80	51.70	9.87
T_3	@ 0 % P (RDF) + @ 100 % Zinc	19.22	8.02	52.06	10.34
T_4	@ 50 % P (RDF) + @ 0 % Zinc	18.63	8.45	52.45	9.57
T_5	@ 50 % P (RDF) + @ 50 % Zinc	19.71	8.82	52.78	10.53
T_6	@ 50 % P (RDF) + @ 100 % Zinc	23.46	9.15	53.12	10.81
T_7	@ 100 % P (RDF) + @ 0 % Zinc	25.73	10.54	54.66	11.73
T_8	@ 100 % P (RDF) + @ 50 % Zinc	24.57	10.08	54.02	11.46
T_9	@ 100 % P (RDF) + @ 100 % Zinc	23.46	9.34	53.45	10.69
	F-Test	S	S	S	S
	S.Ed. (±)	0.360	0.71	1.10	0.147
	C.D. at 0.5%	1.056	1.45	2.25	0.432

4. CONCLUSION

It was found that the different levels of phosphorus and zinc used from different sources of fertilizers [*i.e*., urea (46% N) + SSP (16% P2O5) + MOP (60% K2O) + ZnSO4 (36.5% Zn)] in the experiment gave the best result in Transaction T7 (P @ 100% + Zn @ 0%) followed by Transaction T8, in Transaction T7 the growth and yield coefficients for green gram gave the highest net profit of Rs 69,516.00 with the highest cost interest ratio being 1:2.33. Therefore, it can be recommended to farmers to get the best combination treatment (T7) for higher farm income and sustainable farming.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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