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ANALYSE THE IMPACT OF NPK AND ZINC ON GROWTH AND YIELD ATTRIBUTES OF CLUSTER BEAN (*CYAMOPSIS TETRAGONOLOBA* L.) VAR. PUSA MAUSMI

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ABSTRACT

Cluster bean (*Cyamopsis tetragonoloba* L.) is an economically important leguminous crop known for its high nutritional value and industrial applications. This study investigates the effects of nitrogen (N), phosphorus (P), potassium (K), and zinc (Zn) on the growth and yield attributes of cluster bean. The experiment was conducted on variety Pusa Mausmi at the research farm of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P. during the *Kharif* season in 2023. The experiment was laid out in randomized block design with nine treatments and three replications with Three levels of NPK and Zinc fertilizers were applied to evaluate their individual and interactive effects on plant growth parameters such as plant height and branch number. Yield attributes including pod number, pod length, and yield were also assessed to determine the overall productivity of cluster bean under varying nutrient regimes. Hear the treatment details: T_1: [Absolute control], T_2: NPK equivalent of control + 10 kg/ha Zinc, T_3: NPK equivalent of control + 20 kg/ha Zinc, T_4: N equivalent of 12kg/ha + 25 kg/ha Phosphorus + 12.5 kg/ha Potassium , T_5: N equivalent of 12.5 kg/ha +25 kg/ha Phosphorus + 12.5 kg/ha Potassium + 10 kg/ha Zinc, T_6: N equivalent of 12 kg/ha + 25 kg/ha Phosphorus + 12.5 kg/ha Potassium +20 kg/ha Zinc, T_7: N equivalent of 25 kg/ha + 50 kg/ha Phosphorus + 25 kg/ha Potassium, T_8: N equivalent of 25 kg/ha + 50 kg/ha Phosphorus + 25 kg/ha Potassium + 10 kg/ha Zinc, T_9: N equivalent of 25 kg/ha + 50 kg/ha Phosphorus + 25 kg/ha Potassium + 20 kg/ha Zinc . Growth and yield properties of plant were found best in treatment T_9 as compare with in treatment T_1.

***Key words*:** NPK, Zinc, growth, Yield, Cluster bean etc.

Introduction

Cluster bean (*Cyamopsis tetragonoloba* L.), commonly known as guar, is a leguminous crop widely cultivated in arid and semi-arid regions. It is very hardy and drought tolerant crop (Kherawat *et al*., 2013) . This crop has high economic value due to the presence of gum in its endosperm (35 to 40%) (Chavan *et al*., 2015) Which is essential for its utilization in various industries, including food, pharmaceuticals, and as a source of guar gum, which is a vital thickening agent in many products. Cluster bean pods are rich in soluble fibre and lower blood Cholesterol levels. The cluster bean or guar contains vitamin-C, Vitamin-K and Vitamin-A, dietary fibre, folate, iron and K (Pandey *et al*., 2019).

The Vitamin-K is important for maintaining bones and proper development of fruit. To optimize the growth and yield of cluster beans, understanding and managing soil fertility is crucial. Nutrient management, particularly the application of fertilizers, plays a significant role in enhancing crop performance and achieving higher yields. In the realm of soil fertility management, NPK (Nitrogen, Phosphorus, and Potassium) fertilizers and micronutrients like zinc are fundamental.

Nitrogen is an essential element for proper plant growth and development. It imparts green colour to leaves and stems and enables them for efficient photosynthesis. Due to leguminous nature, major part of Nitrogen requirement can be met through inbuilt mechanism of

atmospheric Nitrogen fixation. Being a legume crop and has the inherent ability to obtain much of its nitrogen requirement from the atmosphere by forming a symbiotic relationship with Rhizobium bacteria in the soil. Pulse crop's ability to use the atmospheric nitrogen through Biological Nitrogen Fixation (BNF) is economically sound and environmentally acceptable (Saikia and Jain, 2007).

Phosphorous is an essential constituent of majority of enzymes, which are of great importance in the transformation of energy, in carbohydrate metabolism, in fat metabolism and in respiration of plants. (Selvaraj and Prasanna (2012).

Potassium is a major plant nutrient and most abundant elements in the soils. Potassium is vital to plant processes owing to its requirement for activation of at least 60 different enzymes involved in plant growth (Singh *et al*., 2011).

Potassium is important for moisture regime within plants. Potassium sufficiently in plants enables them to absorb water and combat stress when water is in short supply. Potassium is important in photosynthesis in translocation of sugars within the plants and for the transport of water and nutrients nitrates, phosphates, calcium, magnesium *etc*.

Zinc deficiency leads to reduction of stem elongation, auxin activities, protein synthesis, flowering and fruit development and also growth period is prolonged resulting in delayed maturity (Tandon, 2009).

Materials and Methods

A field experiment conducted at the Soil Science Research Farm, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. The Crop Research Farm is located at 25°24'30" North latitude and 81°51'10" East longitude and 98 meters (322 feet) above the sea level. The location is 4-5 km away from the city at the right bank of the Yamuna River, which is the Agro-Climatic Zone (Upper Gangetic Plain) and the Agro-ecological Sub Region [North Alluvium plain zone (0-1% slope)]. The Prayagraj district of Uttar Pradesh, is exceptionally hot summers and relatively fairly cold winters, embodies the sub-tropical region of the state's southeast. In summer, the location's highest temperature endures from 46 to 48°C, and in winter, it hardly ever falls below 4 to 5°C. There is a 20-94% difference in relative humidity and average annual rainfall is 1100 mm.

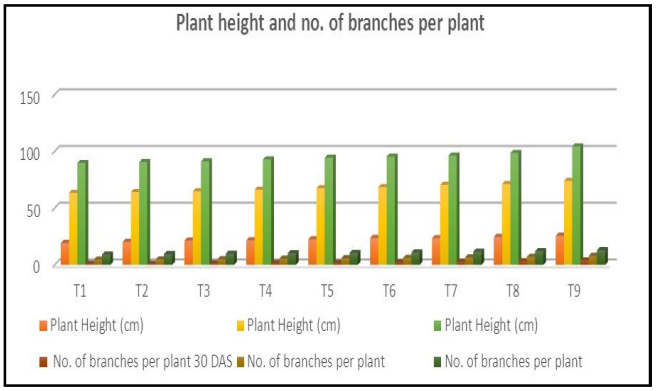

Fig. 1: Graphical representation of effect of NPK and Zinc on plant height, and number of brunches cluster bean (*Cyamopsis tetragonoloba* L.) var. Pusa Mausmi.

This experiment occurred during the Kharif season of years (2023), and growing cluster bean *Var*. *Pusa Mausmi*. The research was laid out in Randomized Block Design (RBD) with 9 treatments and three levels of NPK (0%, 50% and 100%), three levels of FYM (0%, 50% and 100%). Plant height, number of branches per plant, number of pods per plant and pod length, under different treatments were recorded at 30, 60 and 90 days after sowing. The data of the number of pods per plant and yield of green pods were also recorded under different treatment.

Physiological determination

The cluster bean crop was sown on July 2023. Harvesting was done by taking 1m^2 area from each plot. And from it five plants were randomly selected for recording growth and yield parameters. The observations were recorded for plant height (cm), Number of branches/ plants number of pods/plant, green pod yield (q/ha). The observed data was statistically analysed using analysis of variance (ANOVA) .

Results and Discussion

Height of plant at 30, 60, 90 DAS

Inquisition of the data in Table 2 showed that plant hight (25.69 cm, 74.03 cm and 104.4 cm) is higher recorded in T_9 with the application of Nitrogen 25 kg/ha + 50 kg/ha Phosphorus + 25 kg/ha Potassium + 20 kg/ha

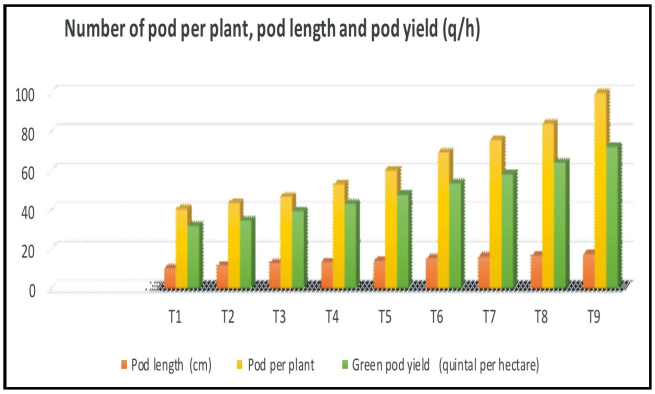

Fig. 2: Graphical representation of effect of NPK and Zinc on number of pods per plant, pod length, and green pod yield cluster bean (*Cyamopsis tetragonoloba* L.) var. Pusa Mausmi.

Table 1: Treatment combination.

Treatment	Treatment Combination
T_1	[Absolute control (NPK @ 0 % + Zinc @ 0 %)]
T_2	[NPK @ 0 % + Zinc @ 50 %]
T_3	[NPK @ 0 % + Zinc @ 100 %]
T_4	[NPK @ 50 % + Zinc @ 0 %]
T_5	[NPK @ 50 % + Zinc @ 50 %]
T_6	[NPK @ 50 % + Zinc @ 100 %]
T_7	[NPK @ 100 % + Zinc @ 0 %]
T_8	[NPK @ 100 % + Zinc @ 50 %]
T_9	[NPK @ 100 % + Zinc @ 100 %]

Zinc, and lowest (19.31cm, 63.55cm and 89.78cm) number of plants height was recorded in T_1.

These might be due to application of nitrogen, phosphorus, potassium, and zinc. Increase in plant height is due to increase in NPK and Zn fertilizers may be due to adequate supply of nutrients which in turn helps in vigorous vegetative growth of plants and subsequently increase the plant through cell elongation, cell division, photosynthesis, and turbidity of plant cell. Similar result has been recorded by (Tiwari *et al.,* 2014;).

Number of brunches Plant^{-1} at 30, 60, 90 DAS

Similarly at 90 days after showing, recorded significantly T_9 with the application of nitrogen of 25 kg/ha along with 50 kg/ha Phosphorus, 25 kg/ha Potassium and 20 kg/ha Zinc recorded maximum number of branches/plant (3.86cm, 7.93cm and 12.92cm). However, the minimum number of brunches Plant $^{-1}$ (0.87cm, 4.58cm and 9.21cm) was recorded in T_1. The application of T_9 produced the highest number of branches. This may be due to application of NPK increased the photosynthetic activity, chlorophyll formation, nitrogen metabolism and auxin contents in the plants which ultimately improving the number of branches. The addition of NPK fertilizers in different concentrations generally increased the number of branches.

Probable reasons for enhanced a greater number of leaves, may be due to promotive effects of NPK and Zn on vegetative growth which ultimately leads to more photosynthetic activities. Similar result has been recorded by (Tiwari *et al*., 2014) (Das *et al*., 2012) and (Ayub *et al.,* 2012).

Number of pod length at 90 DAS

A critical perusal of data pertaining in the Table 2, the effect of different levels of NPK and Zn on pod length of cluster bean was found to be significant at C.D @ 5%. The pod length of cluster bean was found to be maximum 17.63 cm in treatment T_9: (NPK @ 100 % + Zinc @ 100 %) followed by 16.75 cm in treatment T_8: (NPK @ 100 % + Zinc @ 50 %) and minimum 10.28 cm in treatment T_1: [Absolute control (NPK @ 0 % + Zinc @ 0 %)].

The addition of NPK fertilizers in different concentrations generally increased the pod length. This may be due to increased supply of major plant nutrients. Nitrogen accelerates the development of growth and reproductive phases and protein synthesis, thus promoting pod length. Similar result has been recorded by (Singh *et al*., 2015) (Meena, L.R. and Jat, H.S., 2016) and (Anuradha *et al.,* 2017).

Number of pods plant^{-1} at 90 DAS

A critical perusal of data pertaining in the Table 2 the effect of different levels of NPK and Zn on number of pods plant^{-1} of cluster bean was found to be significant at C.D @ 5%. The number of pods plant^{-1} of cluster bean

Table 2: Effect of NPK and Zinc on plant height, number of brunches, number of pods per plant, pod length, and yield of cluster bean (*Cyamopsis tetragonoloba* L.) var. Pusa Mausmi.

Treatments	Plant Height (cm)			No. of brunches Plant^{1}			Pod length (cm)	Pod per plant	Green pod yield (q ha^{-1})
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS			
T_1	19.31	63.55	89.78	0.87	4.58	9.21	10.28	40.56	31.98
T_2	20.29	64.20	90.56	0.99	4.79	9.50	11.72	43.69	34.77
T_3	21.48	64.78	91.25	1.40	5.13	9.92	12.94	47.12	39.63
T_4	21.74	66.25	92.89	1.68	5.59	10.24	13.45	53.37	43.26
T_5	22.56	67.67	94.45	1.85	5.85	10.55	14.12	60.41	47.94
T_6	23.80	68.58	95.45	2.36	6.20	11.03	15.52	69.78	53.82
T_7	23.49	70.51	96.30	2.78	6.60	11.67	16.01	75.97	58.29
T_8	24.73	71.22	98.55	3.23	7.11	12.02	16.75	84.22	64.44
T_9	25.69	74.03	104.40	3.86	7.93	12.92	17.63	102.33	72.52
F- Test	S	S	S	S	S	S	S	S	S
S.Ed. (±)	0.22	0.78	1.21	0.06	0.07	0.09	0.45	0.62	0.51
C.D.@5%	0.46	1.66	2.57	0.12	0.15	0.20	0.96	1.32	1.08
C.V.	1.19	1.41	1.56	3.21	1.45	1.06	3.90	1.19	1.26

was found to be maximum 102.33 in treatment T_9 (NPK @ 100 % + Zinc @ 100%), followed by 84.22 in treatment T_8 (NPK @ 100 % + Zinc @ 50 %) and minimum 40.56 in treatment T_1 [Absolute control (NPK @ 0 % + Zinc @ 0 %)].

The addition of NPK fertilizers in different concentrations generally increased the number of pods. Increased in number of pods may be due to adequate availability of nutrients during reproductive stage of crop results in the formation of more pods. The addition of NPK fertilizers in different concentrations generally increased the number of pods. Probable reasons for enhanced a greater number of pods, may be due to promotive effects of NPK and Zn on vegetative growth which ultimately leads to more photosynthetic activities. Similar result has been recorded by (Dangi *et al*., 2020).

Green pod yield (q ha^{-1}).

The effect of different levels of NPK and Zn on green pod yield of cluster bean was found to be significant at C.D @ 5%. The green pod yield of cluster bean was found to be maximum 72.52 q ha^{-1} in treatment T_9 (NPK @ 100 % + Zinc @ 100 %) followed by 64.44 q ha^{-1} in treatment T_8 (NPK @ 100 % + Zinc @ 50 %) and minimum 31.98 q ha^{-1} in treatment T_1 [Absolute control (NPK @ 0 % + Zinc @ 0 %)].

The addition of NPK fertilizers in different concentrations generally increased the green pod yield. This may be due to increased supply of major plant nutrients. This may be due to favourable effects of nitrogen on overall metabolic processes of the plant and beneficial effects on growth. Zinc and supplementation of phosphorus independently or in combination had

positive effects on cluster bean. Similar result has been recorded by (Singh *et al*., 2015).

Conclusion

From the field experiment revealed that the application of NPK, and Zinc at the different levels had great impact on the overall performance of cluster bean. It is concluded that the best outcomes regarding growth and yield of cluster bean were observed in T_9 (NPK @ 100% + Zinc @ 100%).

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