

**Effect of Different Levels of NPK and Zinc on Soil Health in Black gram  
(*Vigna mungo* L.)**

**ABSTRACT**

An experiment was conducted during in *Zaid* season (March 2022-June 2022) to study the “Effect of Different Levels of NPK and Zinc on Soil Health in Black gram (*Vigna mungo* L.)” on central research farm of Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. A randomized block design was used to set up the experiment, with three levels of NPK (0%, 50%, and 100% NPK) and three levels of zinc (0%, 50%, and 100% zinc). The outcome demonstrates that inorganic fertilizer application had a non-significant (BD, PD, pH, EC and OC) effect on soil physical-chemical parameters and significant increase in pore space, water holding capacity, available nitrogen, phosphorus, potassium and zinc in treatment T<sub>9</sub> [NPK at 100% + zinc at 100%] than other treatments.

**Key word:** NPK, Soil health, Zinc etc.

**Introduction**

A natural body made up of solids (minerals and organic matter), liquid, and gases, soil is defined as "a natural body that occurs on the land surface, occupies space, and is characterised by one or both of the following: horizons, or layers, that are distinguishable from the initial material as a result of additions, losses, transfers, and transformations of energy and matter, or the ability to support rooted plants in a natural environment." As per the United States Department of Agriculture (USDA).

Fertilizers containing nitrogen are crucial for raising crop productivity and enhancing soil fertility. The crop's biomass and grain production rise when nitrogen fertilizer is used. It increases the soil's residual N by 18 to 34%. The effects of sole residue integration or combination with N fertilizer on plant development and production as well as the Physico-chemical characteristics of the soil are favorable. A crucial component that plants need is

nitrogen. It enhances the amount of protein in pulses and the growth and development of all biological tissues. The synthesis of amino acids, chlorophyll, and other organic chemicals that serve as the building blocks of proteins as well as promoting plant growth make nitrogen one of the most important nutrients (Ghosh *et al.*, 2022).

One of the three main macronutrients that plants need for the greatest growth and development is phosphorus (P), which is a crucial nutrient element. Photosynthesis, respiration, energy storage, root growth, cell elongation, and crop quality are all impacted by phosphorus. Plants with deficiencies may have erect, thin stems that are wiry, and their leaves may turn a bluish green tint. The growth of root nodules is boosted, and Rhizobium activity is improved. As a result, it aids in the root nodules' ability to fix more nitrogen from the atmosphere. (Ghosh *et al.*, 2022)

It has been said that potassium is a "quality element" and a "master cation" that is essential for the growth and development of the plant. Numerous crucial enzymes, including those involved in protein synthesis, sugar transport, disease resistance, drought tolerance, N and C metabolism, and photosynthesis, are activated by it. Potassium is crucial for improving quality and raising output (Subba Rao and Tilak, 1977; Balasubramanian, 1999).

The most deficient micronutrient in Indian soils is zinc, which is also considered to be the third-most crucial component for crop productivity after nitrogen and phosphorus. Due to zinc's significant effects on yield qualities and its significance in metabolic processes, the rise in yield may be explained by these factors. According to Hafeez Z *et al.* (2013), zinc contributes to the synthesis of auxin, the activation of dehydrogenase enzymes, and the stabilization of ribosomal fractions.

## **Materials and Methods**

A field experiment to study the Effect of Different Levels of NPK and Zinc on Soil Health in Black Gram (*Vigna mungo* L.) was conducted at central research farm department of Soil Science and Agricultural Chemistry, SHUATS, Prayagraj. This area normally falls under the subtropical belt in the southeast of Uttar Pradesh, where the summers are quite hot and the winters are moderately chilly. The location's highest temperature occasionally drops below 4<sup>0</sup>C or 5<sup>0</sup>C and can reach up to 46<sup>0</sup>C to 48<sup>0</sup>C. Between 20 to 94% the relative humidity was present. Around 1100 mm of rain precipitation occurs yearly on average in this region. The experimental site is located 98 meters above sea level at 25<sup>0</sup> 57'N latitude and 81<sup>0</sup> 59'E longitude. The soil in

the experimental region is classified as Inceptisol, and its texture is sandy loam (sand content: 62.71%; silt content: 23.10%; clay content: 14.1%). The experiment was set up using a randomised block design (RBD), which included nine treatments and three doses of NPK (0, 50, and 100%) and Zn (0, 50, and 100%). Three replicates of the treatment have been made. There were 27 plots in total. Black gramme was planted in 2 x 2 m plots during the zaid season, with a spacing of 30 x 10 cm. Using a soil auger, soil samples were taken from each plot both before and after the experiment at a depth of 0–30 cm. The soil samples were air-dried, put through a 2 mm screen, and then had their different soil qualities examined. M.L. Jackson (1958) assessed the soil pH with a pH meter, and Wilcox (1950) measured the electrical conductivity (EC) with a conductivity meter. The available nitrogen (N) was calculated using the Subbiah and Asija method (1956), the phosphorus (P) was calculated using the Olsen et al. method (1954), the potassium (K) was calculated using the Toth and Prince method (1949), and the zinc (Zn) was estimated using the Lindsay and Norvell method (1978). The soil organic carbon (SOC) was estimated using the Walkley and Black method (1947).

## **RESULT AND DISCUSSION**

Tables 1, 2, and 3 show the impact of NPK and Zn on soil properties. The use of NPK and Zn to soil properties was demonstrated by the findings.

### **Physico-chemical properties**

The response of NPK and Zn levels on the soil's bulk density and particle density was found to be non-significant. The maximum bulk density of soil was found 1.288 Mg m<sup>-3</sup> and 1.296 Mg m<sup>-3</sup> in treatment T<sub>9</sub> (NPK @ 100% + Zn @ 100%) and the minimum was 1.243 Mg m<sup>-3</sup> and 1.250 Mg m<sup>-3</sup> found at soil depths of 0-15 and 15-30 cm in treatment T<sub>1</sub> (NPK @ 0 % + Zn @ 0 %). The maximum particle density was 2.518 Mg m<sup>-3</sup> and 2.526 Mg m<sup>-3</sup> found in T<sub>9</sub> (NPK @ 100 % + Zn @ 100 %) and the minimum was 2.475 Mg m<sup>-3</sup> and 2.482 Mg m<sup>-3</sup> found at soil depths of 0-15 and 15-30 cm in treatment T<sub>1</sub> (NPK @ 0 % + Zn @ 0 %). The maximum organic carbon of soil was found 0.407 and 0.396 in T<sub>9</sub> (NPK @ 100 % + Zn @ 100 %) and minimum was measured 0.375 mg kg<sup>-1</sup> and 0.368 mg kg<sup>-1</sup> at soil depths 0-15 and 15-30cm in treatment T<sub>1</sub> (NPK @ 0 % + Zn @ 0 %). The maximum available nitrogen 324.78 kg ha<sup>-1</sup> and 318.54 kg ha<sup>-1</sup>,

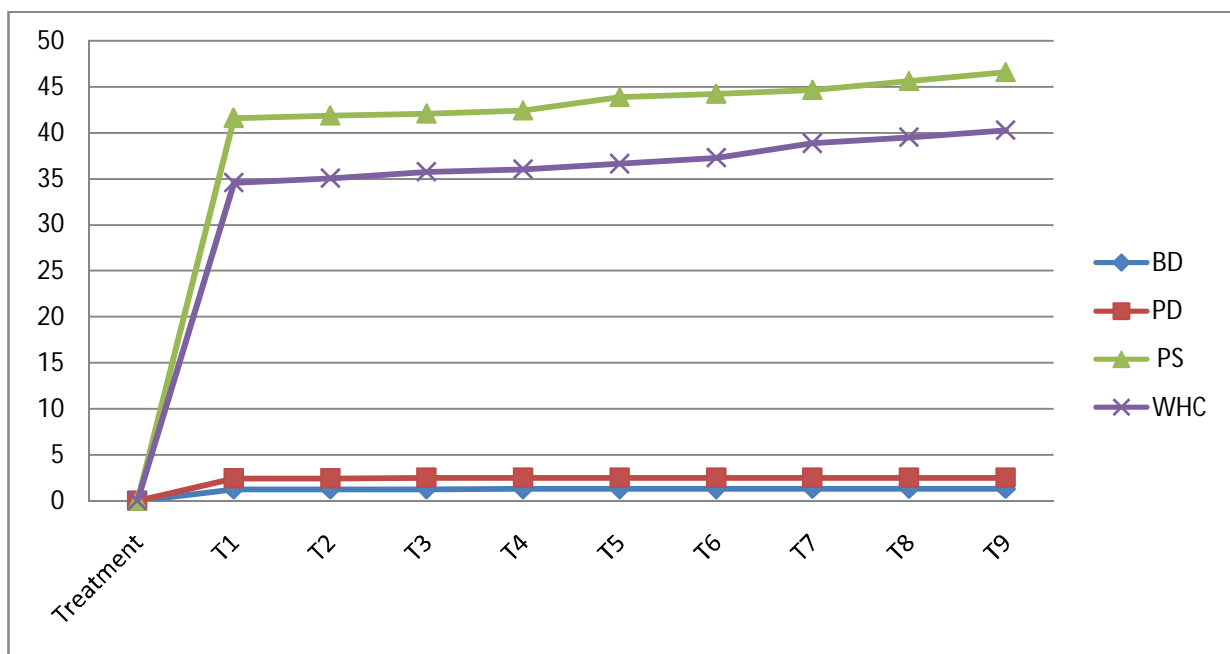
available phosphorus 23.48 kg ha<sup>-1</sup> and 20.86 kg ha<sup>-1</sup> were found in T<sub>9</sub> (NPK @ 100 % + Zn @ 100 %) at soil depths 0-15 and 15-30cm. The maximum potassium availability in soil was measured 210.45 kg ha<sup>-1</sup> and 206.72 kg ha<sup>-1</sup> at 0-15 and 15-30 cm in T<sub>9</sub> (NPK @ 100 % + Zn @ 100 %) while maximum availability of zinc was measured 0.354 mg kg<sup>-1</sup> and 0.359 mg kg<sup>-1</sup> at 0-15 and 15-30 cm in T<sub>9</sub> (NPK @ 100 % + Zn @ 100 %).

### **Conclusion**

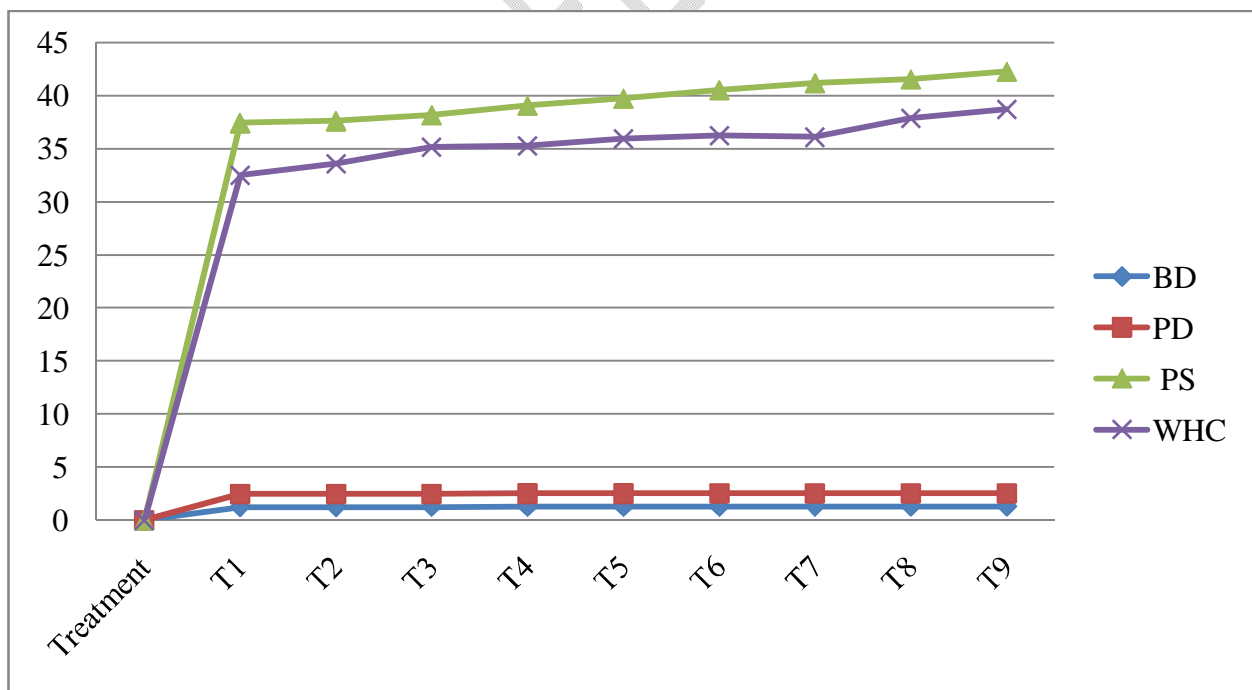
According to the trial, the fertilizers [Urea (46% N), + SSP (16% P<sub>2</sub>O<sub>5</sub>), + MOP (60% K<sub>2</sub>O), + ZnSO<sub>4</sub> (36.5% Zn)] used at different levels of NPK and Zn from different sources produced the best results in treatment T<sub>9</sub> (NPK @ 100% + Zn @ 100%), which was followed by treatment T<sub>8</sub>. In T<sub>9</sub>, the soil health parameters retained the appropriate soil properties. Therefore, for increased farm revenue and sustainable agriculture, it might be advised that farmers receive the finest combination treatment (T<sub>9</sub>).

**Table 1: Effect of NPK and Zn on soil physical properties**

Treatment	BD (Mg m <sup>-3</sup> )		PD (Mg m <sup>-3</sup> )		Pore space (%)		Water holding capacity (%)	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
NPK @ 0 % + Zn @ 0 %	1.243	1.250	2.475	2.482	41.60	37.42	34.55	32.48
NPK @ 0 % + Zn @ 50 %	1.248	1.255	2.480	2.487	41.86	37.60	35.07	33.60
NPK @ 0 % + Zn @ 100 %	1.254	1.262	2.486	2.492	42.08	38.15	35.76	35.18
NPK @ 50 % + Zn @ 0 %	1.260	1.268	2.490	2.497	42.42	39.08	36.04	35.26
NPK @ 50 % + Zn @ 50 %	1.265	1.274	2.495	2.504	43.88	39.72	36.61	35.92
NPK @ 50 % + Zn @ 100 %	1.272	1.278	2.501	2.509	44.22	40.52	37.30	36.22
NPK @ 100 % + Zn @ 0 %	1.276	1.285	2.507	2.515	44.61	41.18	38.84	36.09
NPK @ 100 % + Zn @ 50 %	1.282	1.290	2.512	2.520	45.60	41.56	39.51	37.85
NPK @ 100 % + Zn @ 100 %	1.288	1.296	2.518	2.526	46.58	42.27	40.26	38.71
F-Test	NS	NS	NS	NS	S	S	S	S
S.Ed. (±)	-	-	-	-	0.62	0.48	0.68	0.55
C.D. at 0.5%	-	-	-	-	1.32	0.99	2.06	1.65



**Fig. 1** Effect of different levels of NPK and Zn on BD, PD, PS, and WHC of soil depth (0-15 cm)



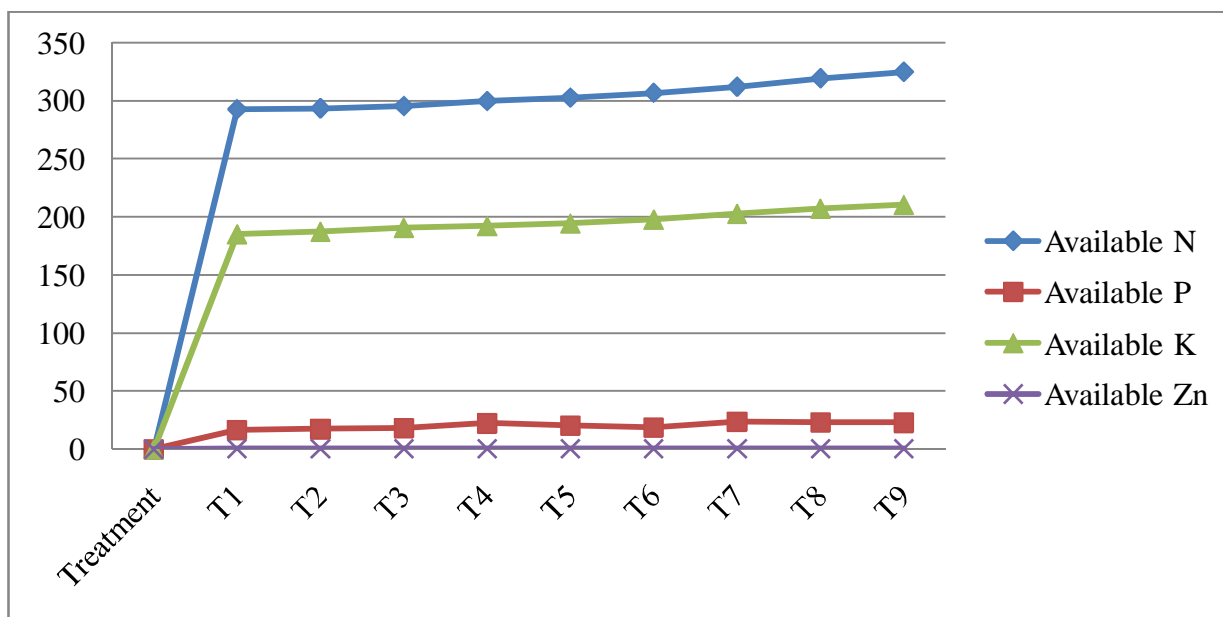
**Fig. 2** Effect of different levels of NPK and Zn on BD, PD, PS, and WHC of soil depth (15-30 cm)

**Table 2: Effect of NPK and Zn on soil chemical properties**

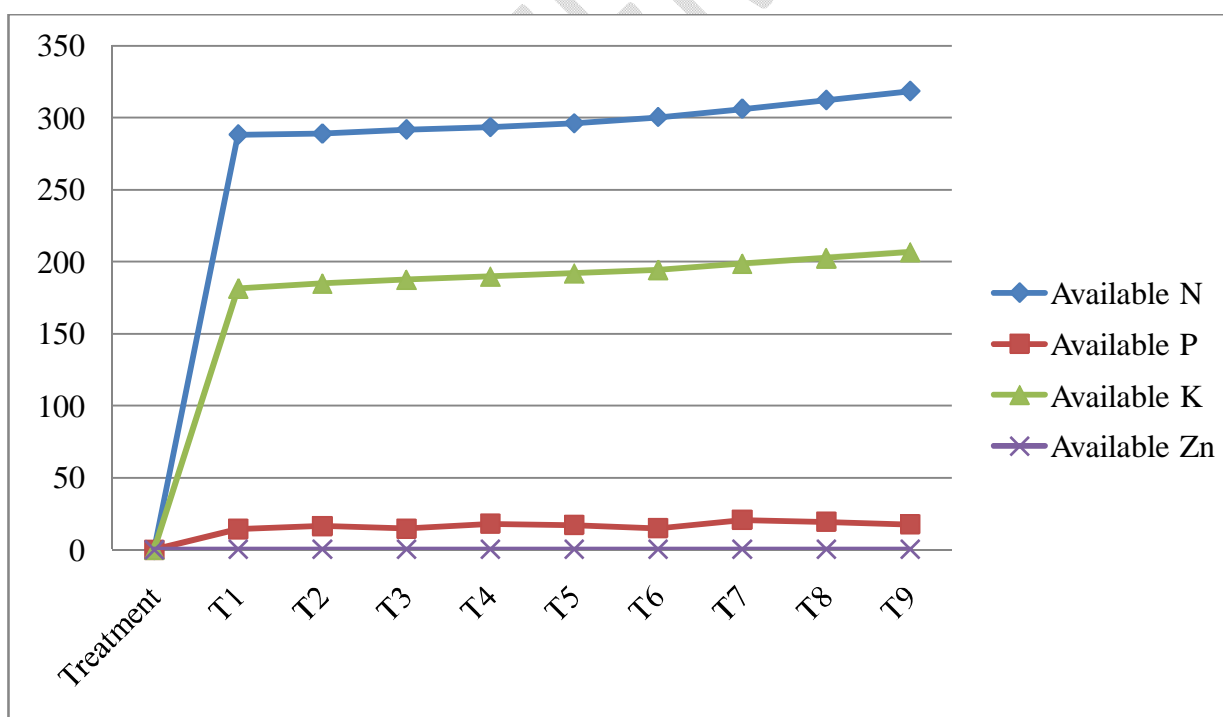
Treatment	pH		EC (dSm <sup>-1</sup> )		Organic carbon (%)	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
NPK @ 0 % + Zn @ 0 %	6.50	6.56	0.442	0.446	0.375	0.368
NPK @ 0 % + Zn @ 50 %	6.57	6.62	0.447	0.449	0.380	0.372
NPK @ 0 % + Zn @ 100 %	6.64	6.68	0.451	0.453	0.384	0.376
NPK @ 50 % + Zn @ 0 %	6.70	6.75	0.454	0.456	0.389	0.379
NPK @ 50 % + Zn @ 50 %	6.76	6.82	0.458	0.463	0.392	0.381
NPK @ 50 % + Zn @ 100 %	6.81	6.86	0.462	0.467	0.395	0.386
NPK @ 100 % + Zn @ 0 %	6.89	6.91	0.465	0.471	0.398	0.390
NPK @ 100 % + Zn @ 50 %	6.94	6.97	0.470	0.475	0.403	0.393
NPK @ 100 % + Zn @ 100 %	7.06	7.14	0.474	0.480	0.407	0.396
<b>F-Test</b>	NS	NS	NS	NS	NS	NS
<b>S.Ed. (±)</b>	-	-	-	-	-	-
<b>C.D. at 0.5%</b>	-	-	-	-	-	-

**Table 3: Effect of NPK and Zn on soil chemical properties**

Treatment	Available Nitrogen (kg ha <sup>-1</sup> )		Available Phosphorus (kg ha <sup>-1</sup> )		Available Potassium (kg ha <sup>-1</sup> )		Available Zinc (mg kg <sup>-1</sup> )	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
NPK @ 0 % + Zn @ 0 %	292.61	288.34	16.41	14.45	185.24	181.56	0.288	0.290
NPK @ 0 % + Zn @ 50 %	293.47	289.06	17.27	16.63	187.42	184.80	0.340	0.352
NPK @ 0 % + Zn @ 100 %	295.38	291.88	17.89	14.85	190.59	187.52	0.354	0.359
NPK @ 50 % + Zn @ 0 %	299.70	293.62	22.18	18.12	192.10	189.77	0.326	0.332
NPK @ 50 % + Zn @ 50 %	302.64	296.29	20.25	17.26	194.54	191.89	0.348	0.337
NPK @ 50 % + Zn @ 100 %	306.82	300.50	18.52	15.08	197.70	194.42	0.336	0.343
NPK @ 100 % + Zn @ 0 %	312.04	306.23	23.48	20.86	202.83	198.61	0.320	0.347
NPK @ 100 % + Zn @ 50 %	319.32	312.35	23.02	19.43	206.97	202.56	0.328	0.324
NPK @ 100 % + Zn @ 100 %	324.78	318.56	22.72	17.89	210.45	206.72	0.343	0.329
<b>F-Test</b>	S	S	S	S	S	S	S	S
<b>S.Ed. (±)</b>	2.18	1.80	1.10	0.68	1.75	1.41	0.12	0.15
<b>C.D. at 0.5%</b>	4.42	3.62	2.23	1.40	3.28	1.85	0.27	0.32



**Fig. 3 Effect of different levels of NPK and Zn on Available N, P, K, and Zn of soil depth (0-15 cm)**



**Fig. 4 Effect of different levels of NPK and Zn on Available N, P, K, and Zn of soil depth (15-30 cm)**

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