Response of NPK, Vermicompost and FYM on Physico-chemical Properties of Soil Under Cluster bean (*Cyamopsis tetragonoloba* L.)

ABSTRACT

Today, with the advancement of environment pollution and health that is obtained from the improper use of inorganic fertilizer, production and use of organic fertilizer is considered as an important approach in the field of soil science in the world's interest to investors. Research was conducted during *Kharif* season 2023 on central research farm of department of soil science and agricultural chemistry, (NAI) SHUATS, Prayagraj. Field trial was designed on Randomized Block Design with three replications and nine treatments. It may be concluded from the trial that the different level of NPK, Vermicompost and FYM in the experiment gave the greatest value. The best results were resulted the greatest Pore Space, Water Holding Capacity, Electrical Conductivity, Available Nitrogen, Phosphorus and Potassium significantly in T_9 [@100% NPK + @ VC 4 t ha^{-1} + @FYM 10 t ha^{-1}]. In contrast, the control treatment T_1 [Absolute Control] had the least results in all categories.

Key word : vermicompost, cluster bean, FYM, NPK.

INTRODUCTION

Soil plays a crucial role in determining the sustainable productivity of agro-ecosystems by supplying essential nutrients to growing plants. The uptake of macronutrients by plants is influenced by various factors, including interactions between major nutrients, as noted by [3] However, soil degradation is becoming increasingly prevalent due to both natural processes and human activities, adversely impacting productivity. With the continuous growth of the human population, there is a greater demand on soil to provide essential nutrients for food and fiber production. Unfortunately, the soil's inherent ability to supply these nutrients has diminished, largely due to increased plant productivity associated with rising food demand [5]. Consequently, a significant challenge today is the development and implementation of soil, crop and nutrient management technologies that improve plant productivity while maintaining the quality of soil, water and air. Assessing soil fertility involves measuring available plant

nutrients and estimating the soil's capacity to sustain a continuous supply of nutrients for crops [4]. Nutrient availability is influenced by factors such as soil type, irrigation methods, pH levels, and organic matter content. [19], the degradation of soil quality concerning productivity or fertility encompasses physical, chemical, and biological processes. Understanding and addressing these degradation processes are essential prerequisites for implementing appropriate conservation activities to monitor and safeguard our natural resource base [13,15,16].

After nitrogen and phosphate, Potassium is the most significant necessary nutrient. It is crucial for plant cell sap, enzymatic activity, photosynthesis, the transportation of sugar, and the synthesis of protein and starch. However, Potassium does not have any chemical bonds with carbon or oxygen. Additionally, it increases the ability of plants to hold off pest and disease attacks and builds tolerance to drought conditions [19]

The application of vermicompost helps to improves and conserves the fertility of soil. Vermicompost imparts a dark colour of the soil and thereby help to maintain the temperature of soil. Vermicompost is one of the manures used by the farmer in growing crops because of early availability and presence of almost all the nutrients required by plants. The composition of vermicompost is 0.6-1.2% N, 0.13-0.22% P and 0.40-0.75. [17]

Farmyard manure refers to the decomposed mixture of dung and urine of farm animals along with litter and left-over material from roughages or fodder fed to the cattle. On an average well decomposed farmyard manure contains 0.5 percent N, 0.25 percent P_2O_5 and 0.5 percent K_2O [7].

The term "guar" derives from the sanskrit word "Gauahar," which means cow fodder or other livestock fodder. An annual legume plant known as the Cluster bean (*Cyamopsis tetragonoloba* L.) (2n=14) is cultivated for its edible, fodder, gum, and green fertilizer qualities. An important legume crop, the cluster bean, also known as "guar," is primarily grown under rainfed conditions in arid and semi-arid areas of India during the *Zaid* season. It is a product that tolerates drought very well. Its deeply penetrating roots give the plant the ability to use the rainfall it has access to more effectively, improving the potential for rainfed cropping. The legume can also withstand mild alkalinity and salinity conditions. There is no other legume product that is as resilient and drought-tolerant as the cluster bean [8].

Young cluster bean pods are consumed as vegetables and are an inexpensive source of energy (16 Kcal), moisture (8 g), protein (3.2 g), fat (1.4 g), carbohydrate (10.8 g), vitamin-A (65.3 IU), vitamin-C (49 mg), calcium (57 mg) and iron (4.5 mg) for every 100 g of edible portion [9].

2. MATERIALS AND METHODS

The experiment was conducted at research Farm of Soil Science and Agricultural Chemistry at Sam Higginbottom University of Agriculture Technology and Sciences Prayagraj the area is situated on the south of Prayagraj on the right side of the river Yamuna on the South of Rewa Road at a distance of about 6 km from Prayagraj city. It is situated at 25^0 57' N latitude, $81^0$59' E longitude and at the altitude of 98 meter above the sea level. The area of Prayagraj district comes under subtropical belt in the South east of Uttar Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46^0C – 48^0C and seldom falls as low as 4^0C – 5^0C. The relative humidity ranged between 20 to 94 percent. The average rainfall in this area is around 1100 mm annually.

Table 1: Physical parameters

Particulars	**Scientist and Year**
Textural class	Bouyoucous (1927) [2]
Soil Colour	Albert Henry Munsell (1971) [11]
Bulk density (Mg m^{-3})	Muthuval *et al*. (1992) [12]
Particle density (Mg m^{-3})	
Pore space (%)	
Water Holding Capacity (%)	

Table 2.: Chemical parameters

Parameters	**Scientist and Year**
Soil pH (1:2.5)	Jackson (1958) [6]
Soil EC (dS m^{-1})	Wilcox (1950) [25]
Organic Carbon (%)	Walkey and Black (1947) [24]
Available Nitrogen (kg ha^{-1})	Subbiah and Asija (1956) [21]
Available Phosphorus (kg ha^{-1})	Olsen *et al*. (1954) [26]
Available Potassium (kg ha^{-1})	Toth and Prince (1949) [23]

Table 3.: Treatment combination

Treatment	**Treatment Combination**	**Symbol**
T_1	[Absolute Control]	**$R_0V_0F_0$**

T_2	@0% NPK + @VC 2 t ha^{-1} + @FYM 5 t ha^{-1}	**$R_0V_1F_1$**
T_3	@0% NPK + @VC 4 t ha^{-1} + @FYM 10 t ha^{-1}	**$R_0V_2F_2$**
T_4	@50% NPK + @VC 0 t ha^{-1} + @FYM 0 t ha^{-1}	**$R_1V_0F_0$**
T_5	@50% NPK + @VC 2 t ha^{-1} + @FYM 5 t ha^{-1}	**$R_1V_1F_1$**
T_6	@50% NPK + @ VC 4 t ha^{-1} + @FYM 10 t ha^{-1}	**$R_1V_2F_2$**
T_7	@100% NPK + @VC 0 t ha^{-1} +@FYM 0 t ha^{-1}	**$R_2V_0F_0$**
T_8	@100% NPK + @VC 2 t ha^{-1} + @FYM 5 t ha^{-1}	**$R_2V_1F_1$**
T_9	@100% NPK + @ VC 4 t ha^{-1} + @FYM 10 t ha^{-1}	**$R_2V_2F_2$**

Note: NPK:- 20:40:40, vermicompost:- 4 t ha^{-1}, FYM:- 10 t ha^{-1}

3. RESULTS AND DISCUSSION

3.1 physical and chemical properties

In this finding research Bulk thickness, Particle Density, pH and EC was found non-significant. The critical varieties were seen in the event of pore space (%). The highest (%) pore space of soil was found in T_9 [@ 100% NPK + @ VC 4 t ha^{-1} + @ FYM 10 t ha^{-1}] and lowest was found in T_1 [Absolute Control] serially. The huge varieties were seen in the event of Water holding capacity (%). The most extreme water holding capacity limit of soil was found in T_9 [@ 100% NPK + @ VC 4 t ha^{-1} + @ FYM 10 t ha^{-1}] and lowest was found in T_1 [Absolute Control] serially. In the event of soil properties, we see that there was tremendous distinction between Organic carbon (%). The highest Organic carbon was kept in T_9 [@ 100% NPK + @ VC 4 t ha^{-1} + @ FYM 10 t ha^{-1}] and lowest was found in T_1 [Absolute Control] serially. In the event of soil properties, we see that there was critical difference between Nitrogen (kg ha^{-1}) and Phosphorus (kg ha^{-1}). The highest Nitrogen and Phosphorus was kept in T_9 [@ 100% NPK + @ VC 4 t ha^{-1} + @ FYM 10 t ha^{-1}] and lowest was found in T_1 [Absolute Control] serially in the event of soil properties, we see that there was massive contrast between Potassium (kg ha^{-1}). The highest Potassium was kept in T_9 [@ 100% NPK + @ VC 4 t ha^{-1} + @ FYM 10 t ha^{-1}] and least was found in T_1 [Absolute Control] serially [10,17,20,22].

4. CONCLUSION

Conclusion Based on the results, the application of NPK, Vermicompost and FYM was found to improve the soil's health in references to cluster bean. Application of T_9 [@ 100%

NPK + @ VC 4 t ha^{-1} + @ FYM 10 t ha^{-1}] was found optimal for improving Soil Properties like Pore space, Water holding capacity, Electrical conductivity, Organic Carbon and Available Nitrogen, Phosphorus, Potassium.

5. ACKNOWLEDGEMENT

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Table 4.: Influence of NPK, Vermicompost and FYM on Bulk Density, Particle Density, Pore Space, Water Holding Capacity and pH.

Treatments		Bulk Density (Mg m^{-3})		Particle Density (Mg m^{-3})		Pore space (%)		Water holding capacity (%)		pH	
T_1	Absolute Control	1.43	1.46	2.64	2.69	42.15	40.27	40.18	38.03	6.902	7.08
T_2	@0% NPK + @VC 2 t ha^{-1} + @FYM 5 t ha^{-1}	1.39	1.43	2.63	2.68	42.86	40.86	40.76	38.61	6.869	7.047
T_3	@0% NPK + @VC 4 t ha^{-1} + @FYM 10 t ha^{-1}	1.33	1.45	2.61	2.66	43.98	41.98	41.88	39.73	6.842	7.02
T_4	@50% NPK + @VC 0 t ha^{-1} + @FYM 0 t ha^{-1}	1.38	1.43	2.62	2.68	43.32	41.32	41.69	39.54	6.856	7.034
T_5	@50% NPK + @VC 2 t ha^{-1} + @FYM 5 t ha^{-1}	1.32	1.42	2.61	2.67	44.52	42.52	42.37	40.22	6.829	7.007
T_6	@50% NPK + @ VC 4 t ha^{-1} + @FYM 10 t ha^{-1}	1.28	1.44	2.6	2.65	45.64	43.64	44.14	41.99	6.796	6.974
T_7	@100% NPK + @VC 0 t ha^{-1} +@FYM 0 t ha^{-1}	1.34	1.42	2.61	2.66	45.15	43.15	42.87	40.72	6.816	6.994
T_8	@100% NPK + @VC 2 t ha^{-1} + @FYM 5 t ha^{-1}	1.30	1.45	2.60	2.64	46.25	44.25	44.81	42.66	6.776	6.954
T_9	@100% NPK + @ VC 4 t ha^{-1} + @FYM 10 t ha^{-1}	1.24	1.41	2.59	2.61	47.36	45.67	45.54	43.39	6.671	6.849
F- test		NS	NS	NS	NS	S	S	S	S	NS	NS
S.Em. (±)		-	-	-	-	1.7985	0.6009	1.364	0.5163	-	-
C.D (P=0.05)		-	-	-	-	5.3919	1.8016	4.089	1.5479	-	-

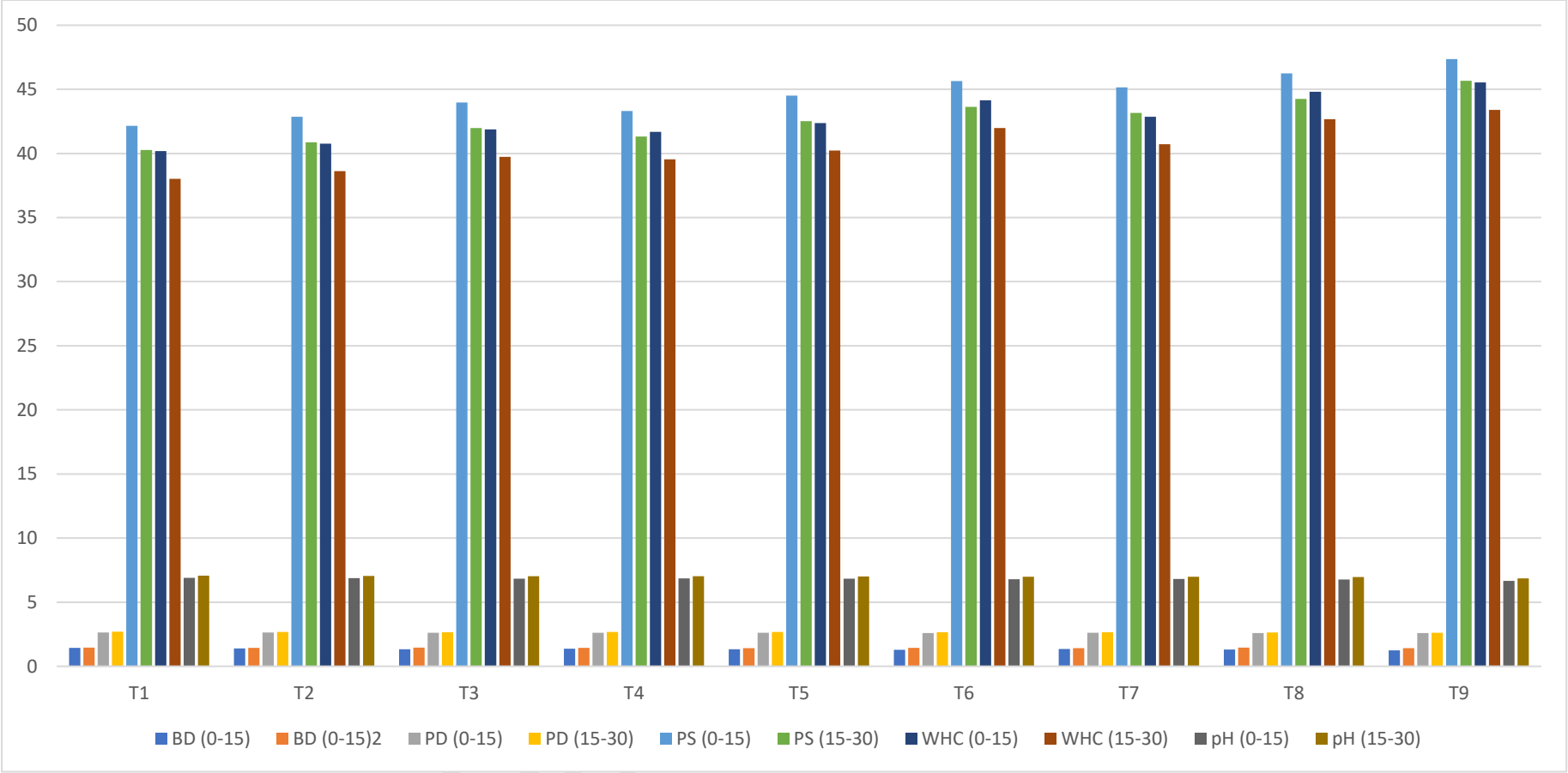

Fig 1.: Influence of NPK, Vermicompost and FYM on bulk Density, Particle Density, Pore Space, Water Holding Capacity and pH.

Table 5.: Influence of NPK, Vermicompost and FYM on Electrical Conductivity, Organic Carbon, Available Nitrogen, Phosphorus and Potassium.

Treatments		Electrical conductivity (dS m^{-3})		Organic carbon (%)		Available Nitrogen (kg ha^{-1})		Available Phosphorus (kg ha^{-1})		Available Potassium (kg ha^{-1})	
T_1	Absolute Control	0.253	0.247	0.39	0.33	254.68	235.18	23.62	21.62	189.74	182.7
T_2	@0% NPK + @VC 2 t ha^{-1} + @FYM 5 t ha^{-1}	0.263	0.257	0.40	0.34	258.32	248.82	25.55	23.55	190.91	183.87
T_3	@0% NPK + @VC 4 t ha^{-1} + @FYM 10 t ha^{-1}	0.286	0.280	0.42	0.36	265.35	255.85	27.77	25.77	195.24	188.2
T_4	@50% NPK + @VC 0 t ha^{-1} + @FYM 0 t ha^{-1}	0.280	0.273	0.41	0.35	263.87	254.37	24.66	22.66	192.93	185.89
T_5	@50% NPK + @VC 2 t ha^{-1} + @FYM 5 t ha^{-1}	0.296	0.290	0.44	0.36	268.59	259.09	26.58	24.58	197.13	190.09
T_6	@50% NPK + @ VC 4 t ha^{-1} + @FYM 10 t ha^{-1}	0.303	0.297	0.43	0.34	275.64	266.14	28.75	26.75	200.15	193.11
T_7	@100% NPK + @VC 0 t ha^{-1} +@FYM 0 t ha^{-1}	0.276	0.270	0.41	0.36	273.87	264.37	26.52	24.24	197.78	190.74
T_8	@100% NPK + @VC 2 t ha^{-1} + @FYM 5 t ha^{-1}	0.306	0.300	0.44	0.35	278.65	269.15	29.64	27.64	202.25	195.21
T_9	@100% NPK + @ VC 4 t ha^{-1} + @FYM 10 t ha^{-1}	0.316	0.310	0.45	0.36	283.48	273.98	31.42	29.05	206.27	199.23
F- test		S	S	S	S	S	S	S	S	S	S
S.Em. (±)		0.007	0.008	0.008	0.011	6.19	5.70	1.20	0.97	0.52	0.54
C.D (P=0.05)		0.022	0.024	0.024	0.033	18.56	17.10	3.60	2.93	1.56	1.63

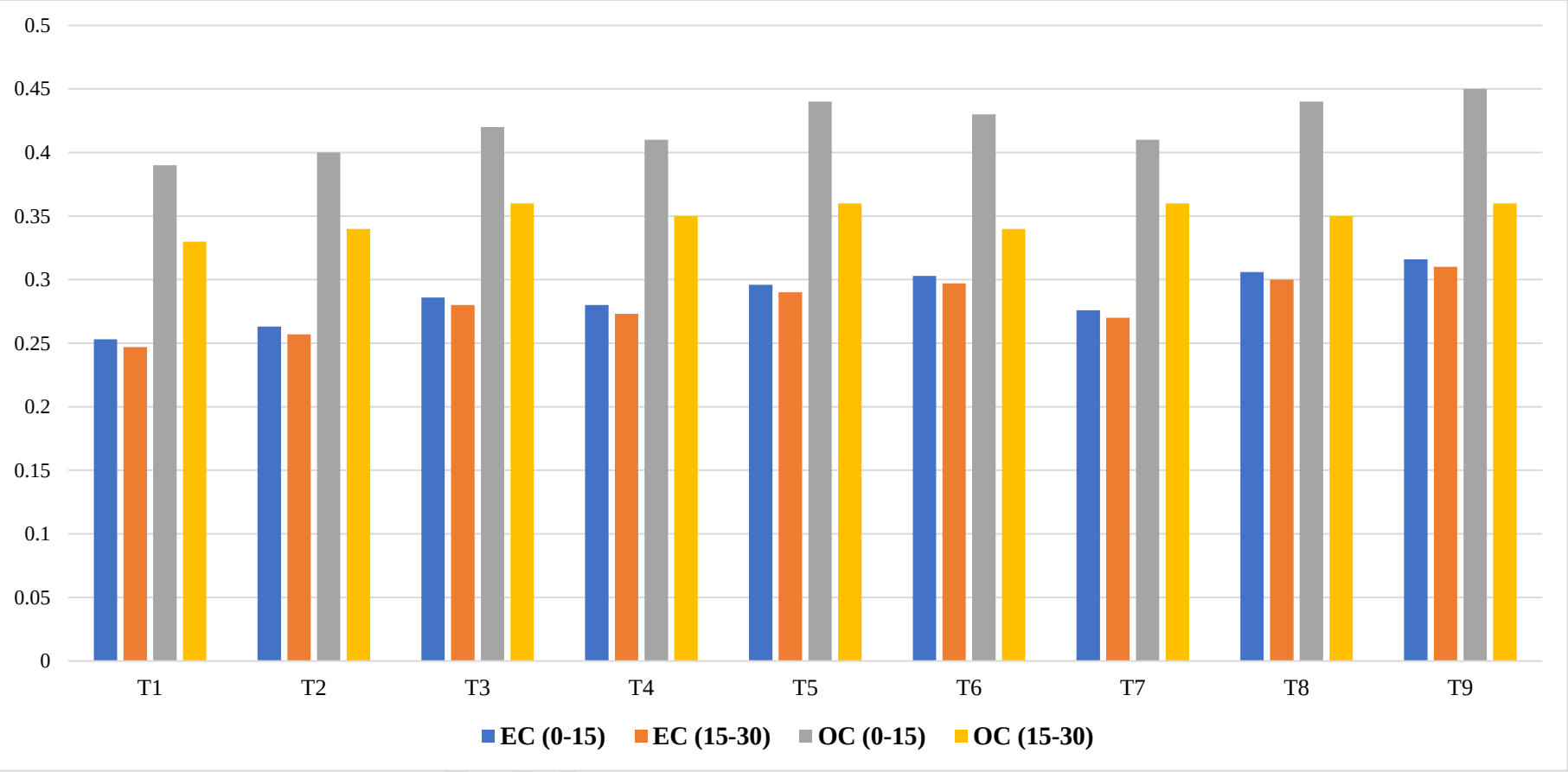

Fig 2.: Influence of NPK, Vermicompost and FYM on Electrical Conductivity and Organic Carbon.

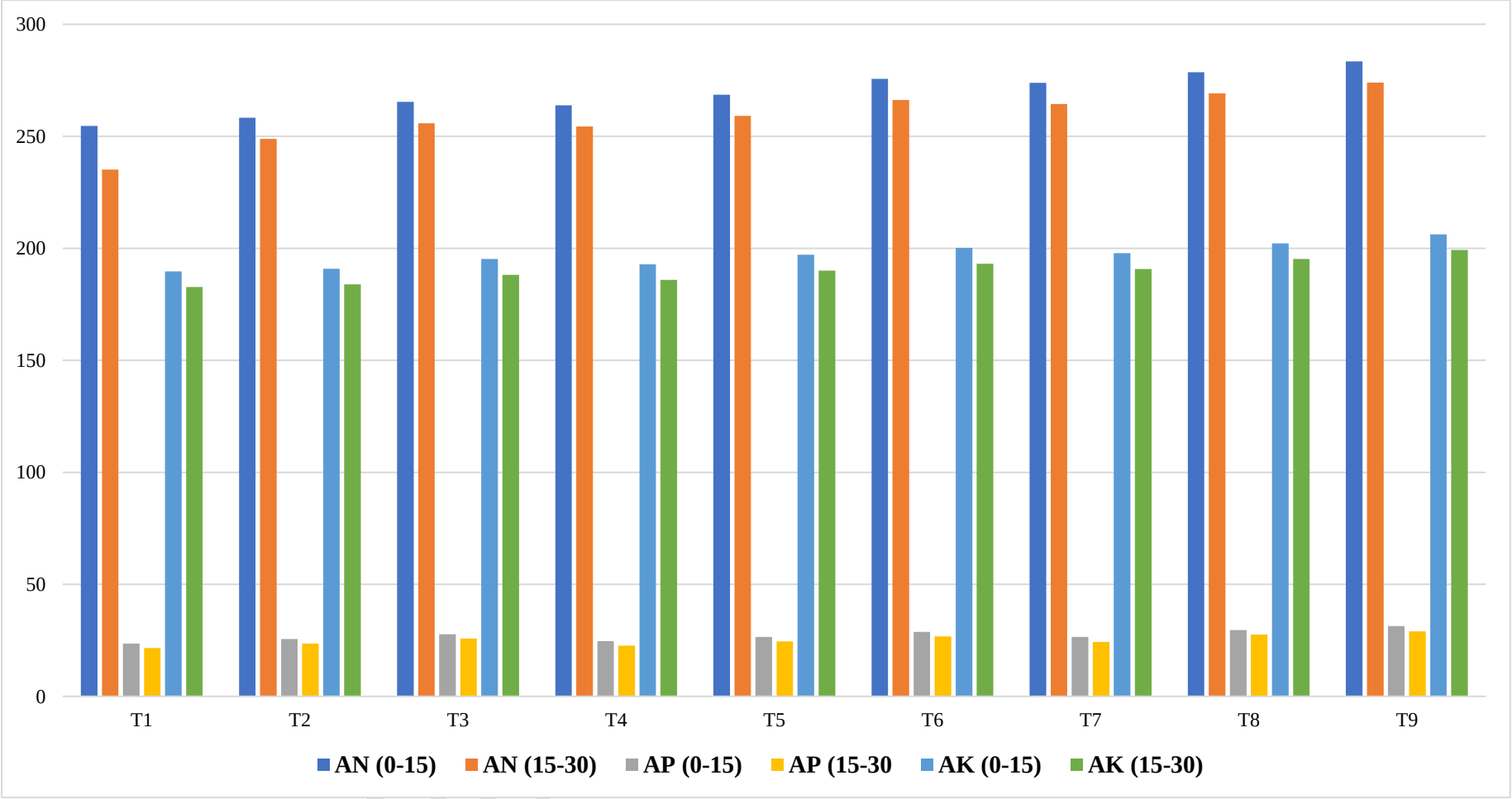

Fig 3: Influence of NPK, Vermicompost and FYM on Available Nitrogen, Phosphorus and Potassium.

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