Assessment of Physio-Chemical Properties of Soil of Hybrid Maize*(Zea mays L.*) as Influenced by Vermicompost and Biofertilizer

ABSTRACT

Field experiment was conducted at Soil Science Research Farm of SHUATS Prayagraj, (U.P.) on, sandy loam soil to" Assessment of Physico-chemical properties of soil, of hybrid maize as Influenced by Vermicompost and Biofertilizer" during kharif season of 2022. There are nine treatment combinations were comprised in randomized block design with three replications.

The results showed that the application of Vermicompost and PSB had a significant and non-significant effect on soil physico-chemical properties. The maximum bulk density (1.34 and 1.37 Mg^{-3}), particle density (2.56 Mg m-3 and 2.62 Mg m-3), pH (7.23 and 7.25) and EC (0.45 and 0.41 dS m^{-1}) was recorded in T1 (Absolute control) at 0-15 and 15-30 cm depth. Similarly, the maximum percentage pore space (47.76 and 47.65%), water holding capacity (45.27 and 45.01%), percentage organic carbon (0.54 and 0.51%), available nitrogen (230.47 and 226.49 kg ha-1), phosphorus (29.29 and 28.29 kg ha-1) and potassium (148.87 and. 140.27 kg ha-1) was recorded in T9 (VC @100% + PSB @ 100%)

Keywords: Soil parameters, Vermicompost, Biofertilizer, maize.

1. INTRODUCTION

Maize is also referred to as the "Queen of Cereals" and a type of fodder. Due to its extensive use as industrial food and feed crops (Sukeet et al., 2011), maize has traditionally been seen as the poor man's crop and as taking up space in wealthy societies. Maize is a member of the Gramineae family and is commonly known as corn. It ranks third in the globe after rice and wheat, and fourth in India after rice, wheat, and sorghum. Maize has a high productivity because to its C4 plant type and efficiency in turning solar energy into dry matter. The crop has high genetic yield potential and hence, it is called as "Miracle crop". Among the Maize growing countries, India rank 4^{th} in area and 7^{th} in production, representing around 4% of the world Maize area and 2% of total production. During 2018-19 in India, the Maize area has reached to 9.2 million ha

The application of vermicompost helps to improve and conserve the fertility of soil. Vermicompost imparts a darks 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 nutrient required by plants. The composition of vermicompost is 0.6-1.2% N, 0.13-0.22 % P and 0.40-0.75 % K.

Vermicompost is described as "bioxidation and stabilization of organic material involving the joint action of earthworms and mesophilic micro-organisms". Worms consume agricultural waste and lower the volume by 40 to 60% when the right circumstances are present. Earthworm activity results in the production of vermicompost, which is high in macro- and micronutrients, vitamins, growth hormones, enzymes including lipase, cellulase, and chitinase, as well as immobilized microflora. Even after leaving the worms, the enzymes continue to break down organic matter. Vermicompost use in agricultural production has many positive effects, including reduced water use for irrigation, decreased pest and termite activity, decreased weed growth, faster seed germination and rapid seedling growth and development, increased fruit production per plant (in vegetable crops), and increased seed production per year (in cereal crops). Without using agrochemicals, earthworms and vermicompost can increase horticulture productivity. Despite the advantages of vermicompost, its application is still not very common. This review aims to spread knowledge about this regional soil amendment.

Biofertilizers are inexpensive, sustainable sources of plant nutrition that are used in addition to chemical fertilizers. These are simply chosen strains of advantageous soil microorganisms that have been cultivated in a lab and packaged in a suitable carrier. They can be applied to soil or used to treat seeds. Through their actions in the soil or rhizosphere, biofertilizers produce plant nutrients like nitrogen and phosphorus and gradually make them available to plants. Inputs such as biofertilizers are also excellent for organic farming and lowering cultivation costs (Perumalla et al., 2020). Biofertilizers, which can increase soil fertility and agricultural yield, are microbial cultures that have been artificially produced from specific soil microorganisms. Through their activity in the soil or rhizosphere, biofertilizers give nutrients like nitrogen and phosphorus to the plants on the soil, making them available to them. Biofertilizers are currently extremely significant since they properly maintain the soil's health and lower environmental pollution by using less chemicals.

2. MATERIALS AND METHODS

The field experiment was conducted at Research Farm of Soil Science and Agricultural Chemistry at Sam Higginbottom University of Agriculture Technology and Sciences,

Prayagraj. It is situated at $25^0 24' 23''$ N latitude, $81^0 50' 38''$ Longitude and at the altitude of 98 meter above the sea level. There are nine treatment combination were comprised in randomized block design with three replications. The treatment combination are T_1-100% RDF Control, T_2-0% Vermicompost+50% PSB, T_3-0% Vermicompost+100 % PSB, T_4 50%Vermicompost+0 %PSB,T_5-50 % Vermicompost + 50 %PSB , T_6 -50 % Vermicompost + 100 % PSB, T_7 - 100 % Vermicompost + 0 %PSB ,T_8 - 100 % Vermicompost + 50 % PSB , T_9 - 100 % Vermicompost + 100 % PSB. Healthy seeds of maize variety Moti were sown 50×20 cm spacing in sandy loam soil. The recommended doses of NPK were applied @120:60:40 $kgha^{-1.}$ The graded level of NPK were applied through Urea, Diammonium phosphate and Murate of potash. Half dose of nitrogen and full dose of phosphorus and potassium were applied basally at the time of sowing. The soil samples were collected randomly from the experimental field to ascertain the nutrient status of each plot at 0-15 and 15-30 cm depth. The size of the soil sample was reduced by air-drying and crushing with the wooden hammer and then passed through a 2 mm sieve, conning and quartering to prepare the composite soil sample for physical and chemical analysis.

Table 1: Treatment details

TREATMENT	TREATMENT COMBINATION	SYMBOOL
T_1	Absolute Control	VC_0PSB_0
T_2	Vermicompost @ 0% + PSB @ 50%	VC_0PSB_{10}
T_3	Vermicompost @ 0% + PSB @ 100 %	VC_0PSB_{20}
T_4	Vermicompost @ 50%+ PSB @ 0 %	VC_2PSB_0
T_5	Vermicompost @ 50 %+ PSB @ 50 %	VC_2PSB_{10}
T_6	Vermicompost @ 50 %+ PSB @ 100 %	VC_2PSB_{20}
T_7	Vermicompost @ 100 %+ PSB @ 0 %	VC_4PSB_0
T_8	Vermicompost @ 100 % + PSB @ 50 %	VC_4PSB_{10}
T_9	Vermicompost @ 100 %+ PSB @ 100 %	VC_4PSB_{20}

3. Result and Discussion

3.1 Soil Physical Properties

The interaction effect of VC and PSB on the bulk density of soil after crop harvest was also found significant. The maximum bulk density 1.34 and 1.37Mgm^{-3} of soil was revealed at 0-15 and 15-30 cm depth in VC_0PSB_0 and minimum bulk density 1.31 and 1.32 Mgm^{-3} of soil was found in $VC_4PSB_{20.}$The interaction effect/response of VC and PSB on the

Particle density of soil after crop harvest was found significant. The maximum Particle density 2.56 and 2.62 Mgm^{-3} of soil was revealed at 0-15 and 15-30 cm depth in VC_0PSB_0 and minimum Particle density 2.40 and 2.44 Mgm^{-3} of soil was found in $VC_4PSB_{20.}$ The interaction effect/response of VC and PSB on the Pore space of soil after crop harvest was found significant. The maximum Pore space 47.76 and 47.65 % of soil was revealed at 0-15 and 15-30 cm depth in $VC_{20}PSB_{20}$ and minimum Pore space 45.3 and 45.25 % of soil was found in VC_0PSB_0The interaction effect/response of VC and PSB on the Water Holding Capacity of soil after crop harvest was found significant. The maximum Water Holding Capacity 45.27 and 45.01 % of soil was revealed at 0-15 and 15-30 cm depth in $VC_{20}PSB_{20}$ and minimum Water Holding Capacity 42.27 and 42.16 % of soil was found in VC_0PSB_0

Table 2: Influence of Vermicompost and Biofertilizer on bulk density, particle density, pore space, and water holding capacity of soil.

Block	BD (Mg m^{-3})		PD (Mg m^{-3})		Pore space (%)		WHC (%)	
	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30
VC_0PSB_0	1.34	1.37	2.56	2.62	45.3	45.25	42.27	42.16
VC_0PSB_{10}	1.34	1.34	2.51	2.58	45.55	45.53	43.24	43.16
VC_0PSB_{20}	1.33	1.34	2.48	2.52	45.86	45.84	43.28	43.25
VC_2PSB_0	1.33	1.34	2.46	2.49	46.07	46.05	44.27	44.24
VC_2PSB_{10}	1.33	1.33	2.45	2.48	46.09	46.01	44.89	44.3
VC_2PSB_{20}	1.32	1.33	2.45	2.47	46.2	46.00	44.94	44.75
VC_4PSB_0	1.32	1.34	2.44	2.46	46.3	46.25	44.98	44.8
VC_4PSB_{10}	1.32	1.32	2.42	2.44	46.76	46.74	45.01	44.94
VC_4PSB_{20}	1.31	1.32	2.40	2.45	47.76	47.65	45.27	45.01

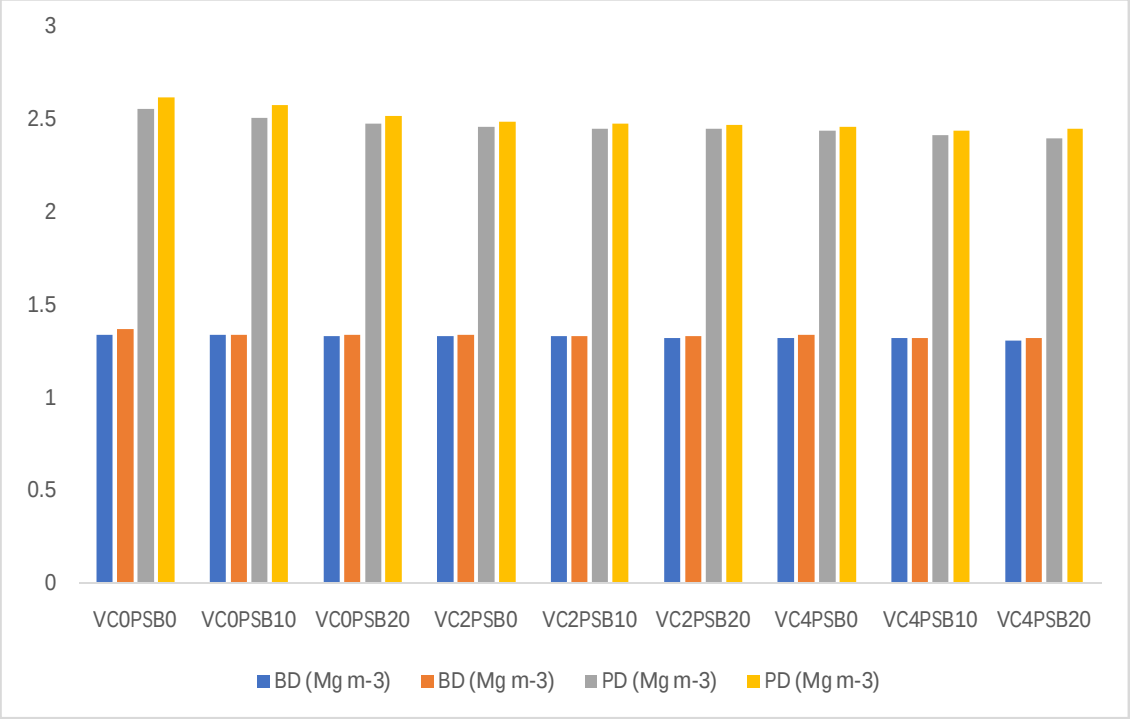

Fig 1: The influence of VC and PSB on the bulk density and particle density of soil after crop harvest.

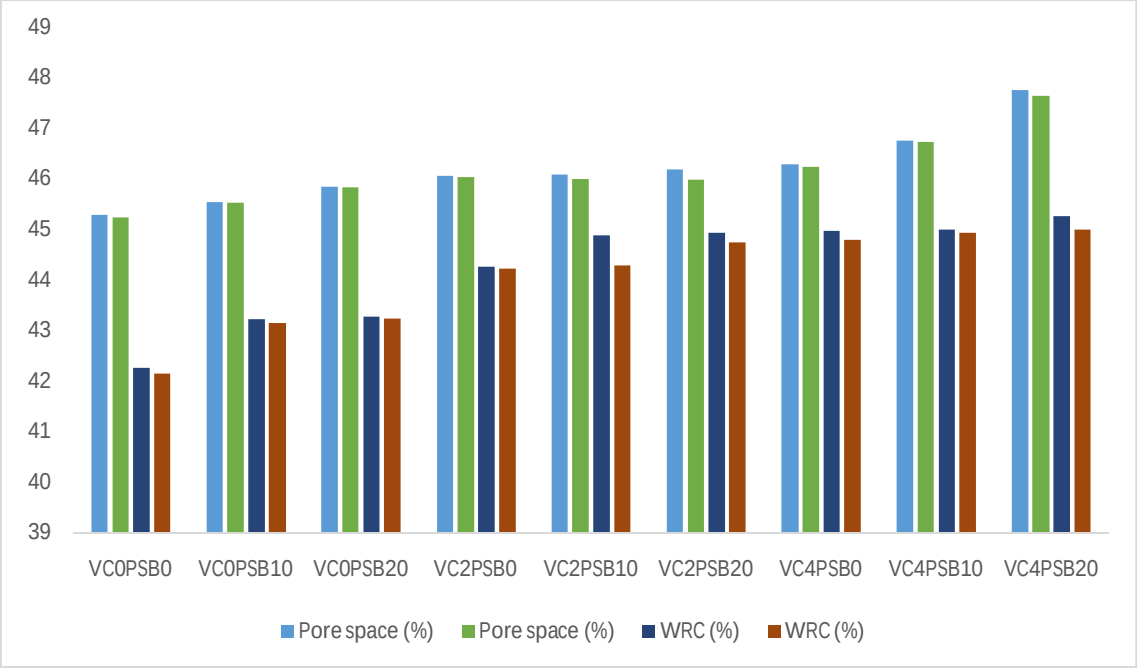

Fig 2: The influence of VC and PSB on Pore space (%) and Water Retaining Capacity of soil after crop harvest.

3.2 Soil Chemical Properties

The interaction effect/response of VC and PSB on the pH of soil after crop harvest was found significant. The maximum pH 7.23 and 7.25 of soil was revealed at 0-15 and 15-30 cm depth in VC_0PSB_0 and minimum pH 6.98 and 7.01 of soil was found in $VC_4PSB_{20.}$ The interaction effect/response of VC and PSB on the EC (dSm^{-1}) of soil after crop harvest was found significant. The maximum EC (dSm^{-1}) 0.45 and 0.41 of soil was revealed at 0-15 and 15-30 cm depth in VC_0PSB_0 and minimum EC (dSm^{-1}) 0.32 and 0.25 of soil was found in $VC_4PSB_{20.}$ The interaction effect/response of VC and PSB on the % Organic carbon of soil after crop harvest was found significant. The maximum % Organic carbon0.54 and 0.51 of soil was revealed at 0-15 and 15-30 cm depth in VC_4PSB_{20} and minimum % Organic carbon 0.34 and 0.33 of soil was found in $VC_0PSB_{0.}$ The interaction effect/response of VC and PSB on the Nitrogen ($Kgha^{-1}$) of soil after crop harvest was found significant. The maximum Nitrogen ($Kgha^{-1}$) 230.47 and 226.49 of soil was revealed at 0-15 and 15-30 cm depth in VC_4PSB_{20} and minimum Nitrogen ($Kgha^{-1}$) 206.26 and 205.17 of soil was found in VC_0PSB_0 The interaction effect/response of VC and PSB on the Phosphorus ($Kg\ ha^{-1}$) of soil after crop harvest was found significant. The maximum Phosphorus ($Kg\ ha^{-1}$) 29.29 and 28.29 of soil was revealed at 0-15 and 15-30 cm depth in VC_4PSB_{20} and minimum Phosphorus ($Kg\ ha^{-1}$) 16.87 and 16.26 of soil was found in $VC_0PSB_{0.}$ The interaction effect/response of VC and PSB on the Potassium ($Kg\ ha^{-1}$) of soil after crop harvest was found significant. The maximum Potassium ($Kg\ ha^{-1}$) 144.87 and 140.27 of soil was revealed at 0-15 and 15-30 cm depth in VC_4PSB_{20} and minimum Potassium ($Kg\ ha^{-1}$) 127.83 and 125.36 of soil was found in $VC_0PSB_{0.}$

Table 3: Influence of Vermicompost and Biofertilizer on pH, electrical conductivity and organic carbon of soil.

Block	pH		EC (dSm^{-1})		OC (%)	
	0-15	15-30	0-15	15-30	0-15	15-30
VC_0PSB_0	7.23	7.25	0.45	0.41	0.34	0.33
VC_0PSB_{10}	7.21	7.23	0.44	0.42	0.37	0.35
VC_0PSB_{20}	7.15	7.17	0.42	0.31	0.38	0.37
VC_2PSB_0	7.12	7.15	0.43	0.32	0.41	0.38
VC_2PSB_{10}	7.11	7.13	0.4	0.3	0.42	0.40
VC_2PSB_{20}	7.02	7.11	0.37	0.25	0.44	0.41

VC_4PSB_0	7.01	7.05	0.36	0.26	0.45	0.44
VC_4PSB_{10}	6.99	7.03	0.34	0.26	0.50	0.46
VC_4PSB_{20}	6.98	7.01	0.32	0.25	0.54	0.51

Table 4: Influence of Vermicompost and Biofertilizer on available nitrogen, available phosphorus and available potassium of soil.

Block	N (kg ha^{-1})		P (kg ha^{-1})		K (kg ha^{-1})	
	0-15	**15-30**	**0-15**	**15-30**	**0-15**	**15-30**
VC_0PSB_0	206.26	205.17	16.87	16.26	127.83	125.36
VC_0PSB_{10}	211.59	211.19	17.36	17.26	136.37	134.29
VC_0PSB_{20}	221.26	220.2	18.89	18.39	141.27	139.27
VC_2PSB_0	209.36	207.16	17.26	17.01	131.11	130.11
VC_2PSB_{10}	216.58	216.48	21.39	20.01	135.27	133.26
VC_2PSB_{20}	226.29	225.29	25.36	24.46	143.27	141.39
VC_4PSB_0	210.26	206.49	19.29	18.26	130.11	129.27
VC_4PSB_{10}	220.29	217.39	23.49	22.26	140.34	138.29
VC_4PSB_{20}	230.47	226.49	29.29	28.29	148.87	140.27

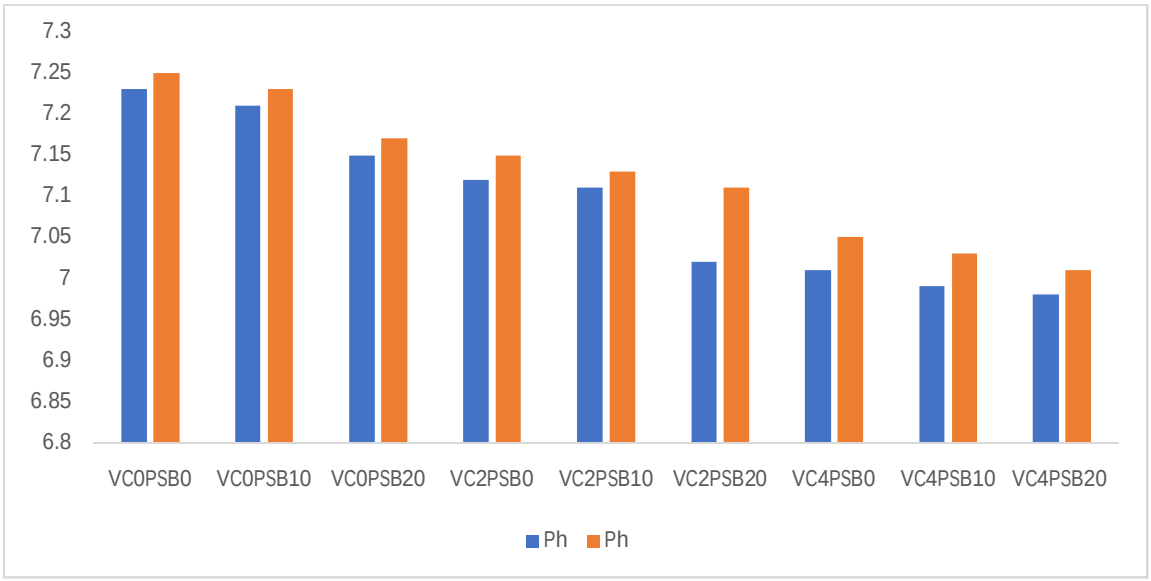

Fig 3: The influence of VC and PSB on pH of soil after crop harvest.

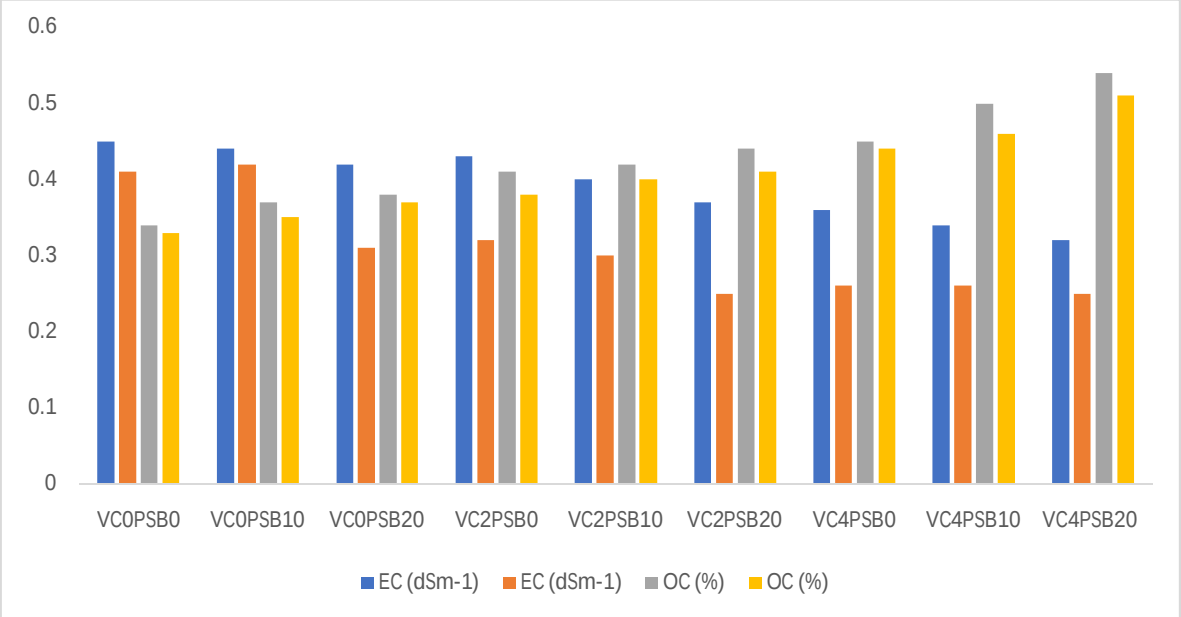

Fig 4: The effect of VC and PSB on EC and Organic Carbon of soil after crop harvest.

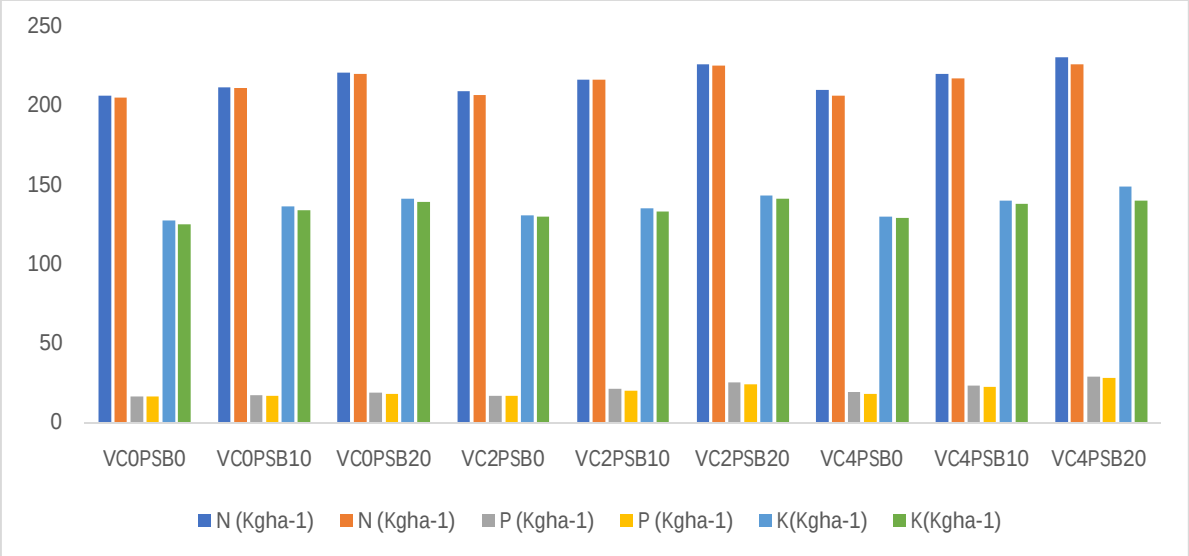

Fig 5: The effect of VC and PSB on Available NPK of soil after crop harvest

CONCLUSION

The results of experiment concluded as the application of Vermicompost and PSB in treatment T_9 (VC_4PSB_{20}) was found sample most effective in improving physico-chemical

properties of soil as decrease in bulk density, particle density, pH, and electrical conductivity, an increase in Pore space, Water retaining capacity, organic carbon and Available Nitrogen, Phosphorus and Potassium. Similarly, the maximum plant height, number of leaves per plant, number of cobs per plant, number of grains per cobs, average cob weight, grain yield and Harvesting index was found in treatment T_9 (VC_4PSB_{20}). The economically of different treatment concerned, the treatment T_9 (VC_4PSB_{20}) provides maximum Gross Return ₹ 87475.00 ha^{-1}, Net Return of ₹ 31217.00 ha^{-1} with Cost benefit ratio is 1:1.13 in. $VC_2PSB_{0.}$

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