ASSESSMENT OF PHYSICO-CHEMICAL PROPERTIES OF SOIL FROM DIFFERENT BLOCKS OF MIRZAPUR DISTRICT, UTTARPRADESH, INDIA

ABSTRACT

An Assessment of Physico-chemical properties of soil from different blocks of Mirzapur district, Uttar Pradesh carried out 2023-24. The prime objectives of this study were to carried out the physico-chemical properties of soil at different Blocks of Mirzapur District, Uttar Pradesh to determine the availability of macro nutrient in the soil. Soil samples were collected with depth of 0-15 cm, 15-30 cm and 30-45 cm respectively. Soil textural classes were sandy loam. Bulk Density (1.17Mg m-3 to 1.44Mg m-3). Particle Density (2.22 Mg m-3 to 2.48 Mg m-3). % Pore Space (42.78% to 48.00) %. It clearly indicated that soil has good Water Holding Capacity (39.92 to 45.76) % and good physical condition, The pH of soil is alkaline nature (7.43 to 8.15) and the Electrical Conductivity (0.21 to 0.34 dSm-1) was suitable for all crops. These soils have low Organic carbon (0.27 to 0.38%). Nitrogen range is medium (250 kg ha-1 to 380 kg ha-1) in all villages. Phosphorus (22.53 kg ha-1 to 37.49 kg ha1) content is medium in all villages. Potassium (148.43 kg ha-1 to 282.4 kg ha-1). is medium at eight locations and high in one location.

Keywords:

INTRODUCTION

Soil suitability for agriculture is mostly determined by its physical characteristics. The physical characteristics of the soil are closely related to its capacity to support life, to move, retain, and make water and nutrients available to plants, to facilitate root penetration, and to allow for the passage of heat and air. Chemical and biological qualities are influenced by physical attributes as well. an explanation of the physical characteristics of soils and their significance for nutrient and water mobility as well as the growth of vegetation cover.**(Phogat *et al.*, (2015).** Soil is the base for the existence of many life forms and an indispensable medium for plant growth. The overarching definition that resonates today is "Soil is a natural independent body which like any other natural body or organism, has a specific origin, history of development, and external appearance" **(Hartemink *et al.*, 2016**). Soil formation is a constructive as well as destructive process. Soil is composed of particles of broken rock that have been altered by chemical and mechanical processes that weathering and erosion. Soil has a complex function which is beneficial to human and other living organism Soil is not merely a group of mineral particles. It has also a biological system of living organism as well as some other components. The climate and other factor largely affect the soil formation. (**Tale and Ingole,2015**) The study of soil is known as Soil Science or pedology (pedo means Soil) and (logy means to study). This study is also known as Edaphology (Edaphos means Soil). Soil may also be defined as the part of the earth crust in which humus is present as in organic part (**Das, 2021).**

MATERIALS AND METHODS

Sampling site and collection

Mirzapur is located at 25.15°N 82.58°E. It has an average elevation of 80 metres (265 feet). The District of Mirzapur lies between the parallels of 23.52 & 25.32 North latitude and 82.7 and 83.33 East longitude. It forms a portion of the Varanasi district. On the north and north-east it is bounded by the Varanasi district; on the south bounded by Sonbhadra district; on the north-west by Allahabad district. The shape to the north and west is totally regular. In no direction, except for about 13 km. in the north-east where the Ganges separates the Tehsil of Chunar from the district of Varanasi, has Mirzapur a natural frontier. The Chanvar fields, considered to be one of the most fertile lands tracts in India, are located on Gangetic flood plains of the district..

Mirzapur district lies in the South-East part of Uttar Pradesh. With an area of 4521 km2 and population of more than 20 lacs, the district is divided in four sub division, 12 blocks and 973 gramsabhas containing 1698 villages. Agro-climatically, the district falls under two zones, viz. Indo-Gangetic Plains covering only 30-40 percent of the total area and Vindhyan Zone covering remaining area. The area under Gangetic Plains is endowed with rich alluvial and fertile soil and good irrigation facilities while the Vindhyan Zone has meagre resource of water and the land is mostly degraded.

Soil samples were collected from 3 different Blocks of Mirzapur district in Uttar Pradesh.. Samples were collected randomly using soil auger by composite sampling method at depths of 0-15, 15-30 and 30-45 cm. All the samples were divided into four parts and then among them two samples were collected and only half kg sample is being taken for the soil analysis by the conning and quartering method.

Table 1. The methods of analysis for different soil parameters

S. No.	Particulars	Scientist Name	Methods	Unit
		PHYSICAL PROPERTIES		
1.	Bulk density	Muthuval *et al.* (1992)	Graduated measuring cylinder	Mg m^{-3}
2.	Particle density	Muthuval *et al.* (1992)	Graduated measuring cylinder	Mg m^{-3}
3.	Textural class (Sand, Slit, Clay)	Bouyoucos (1927)	Bouyoucos hydrometer	Percentage (%)
4.	Pore space	Muthuval *et al.* (1992)	Graduated measuring cylinder	Percentage (%)
5.	Water Holding capacity	Muthuval *et al.* (1992)	Graduated measuring cylinder	Percentage (%)
		CHEMICAL PROPERTIES		
1.	Soil pH (1:2.5)	Jackson (1958)	Digital pH meter	
2.	Electrical conductivity (1:2.5)	Wilcox (1950)	Digital conductivity meter	dS m^{-1}
3.	Organic carbon	Walkley and Black (1947)	Wet oxidation method	Percentage (%)
4.	Available nitrogen	Subbiah and Asija (1956)	Soil alkaline permanganate method	kg ha^{-1}
5.	Available phosphorus	Olsen *et al.* (1954)	Photometric colorimeter method	kg ha^{-1}

6.	Available potassium	Toth and Prince (1949)	Flame photometric method	kg ha^{-1}

RESULT AND DISCUSSION

Physical Properties

The textural classification of soil in different villages Mirzapur block. The texture classification of soil samples was shown **Sandy loam** in all villages.

Soil Bulk Density (Mg m^{-3})

The bulk density in a soil ranges from 1.17 -1.48 Mg m^{-3}. V_6 – Indi Parwatpur was reported as highest bulk density *i.e.*, 1.48 (Mg m^{-3}) while V_3 Amirati was reported as lowest bulk density *i.e.* 1.17 (Mg m^{-3}). Significant results were observed by **(Ghosh *et al.*, 2021).**

Soil Particle Density (Mg m^{-3})

Soilparticle densityranges from 2.22– 2.55 Mg m^{-3}. V_1 – Aksauli was reported as highest particle density *i.e.* 2.55 (Mg m^{-3}), and lowest was found in V_3 - Amirati *i.e.* 2.22 (Mg m^{-3}). Similar results were reported by **(Ghosh *et al.*, 2021)**

Soil Porosity (%)

Soil porosity in a soil sample ranges from 40.61 – 48.00 %. V_1 -Aksauli reported as highest porosity of 48.00 % while V_6 – Indi Parwatpur reported as lowest porosity *i.e.* 40.61%. Significant results were observed by **(Ghosh *et al.*, 2021)**

Water Holding Capacity (%)

The values of water holding capacity of soil ranges from 39.37– 45.17%. Highest water holding capacity was observed in the V_1 - Aksauli which was 45.17% ,whereas the lowest water holding capacity was observed in V_6 – Indi Parwatpur *i.e.* 39.37% . Similar results were reported by **(Ghosh *et al.*, 2021).**

Table 2. Soil physical properties

	bulk density(Mg m^{-3})			particle density(Mg m^{-3})			Pore space(%)			water holding capacity(%)		
	0-15 cm	15-30 cm	15-45 cm	0-15 cm	15-30 cm	15-45 cm	0-15 cm	15-30 cm	15-45 cm	0-15 cm	15-30 cm	15-45 cm
V_1	1.29	1.31	1.35	2.48	2.52	2.55	48.00	47.82	46.45	45.17	43.19	41.78
V_2	1.31	1.33	1.35	2.32	2.35	2.38	43.51	43.00	42.80	42.76	40.78	39.37
V_3	1.17	1.25	1.29	2.22	2.25	2.27	47.33	44.50	42.70	44.19	42.81	40.18
V_4	1.34	1.39	1.44	2.42	2.47	2.50	44.63	43.74	42.36	43.39	41.78	40.17
V_5	1.30	1.35	1.39	2.44	2.48	2.52	46.74	45.54	44.85	44.15	42.03	40.35
V_6	1.44	1.48	1.48	2.41	2.44	2.44	42.78	40.61	40.61	40.18	39.37	39.37
V_7	1.25	1.29	1.33	2.29	2.33	2.35	45.62	44.64	43.37	43.07	41.35	39.75
V_8	1.29	1.33	1.36	2.35	2.38	2.40	45.09	44.11	43.26	43.31	41.17	49.17
V_9	1.31	1.35	1.42	2.45	2.46	2.50	46.52	45.03	43.18	44.13	42.30	40.39
F- test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
S.Em. (±)	**0.023**	**0.020**	**0.020**	**0.037**	**0.382**	**0.323**	**0.656**	**0.767**	**0.645**	**0.610**	**0.610**	**0.683**
C. D. @ 5 %	**0.070**	**0.061**	**0.060**	**0.118**	**0.113**	**0.096**	**1.949**	**2.280**	**1.919**	**1.814**	**1.813**	**2.030**

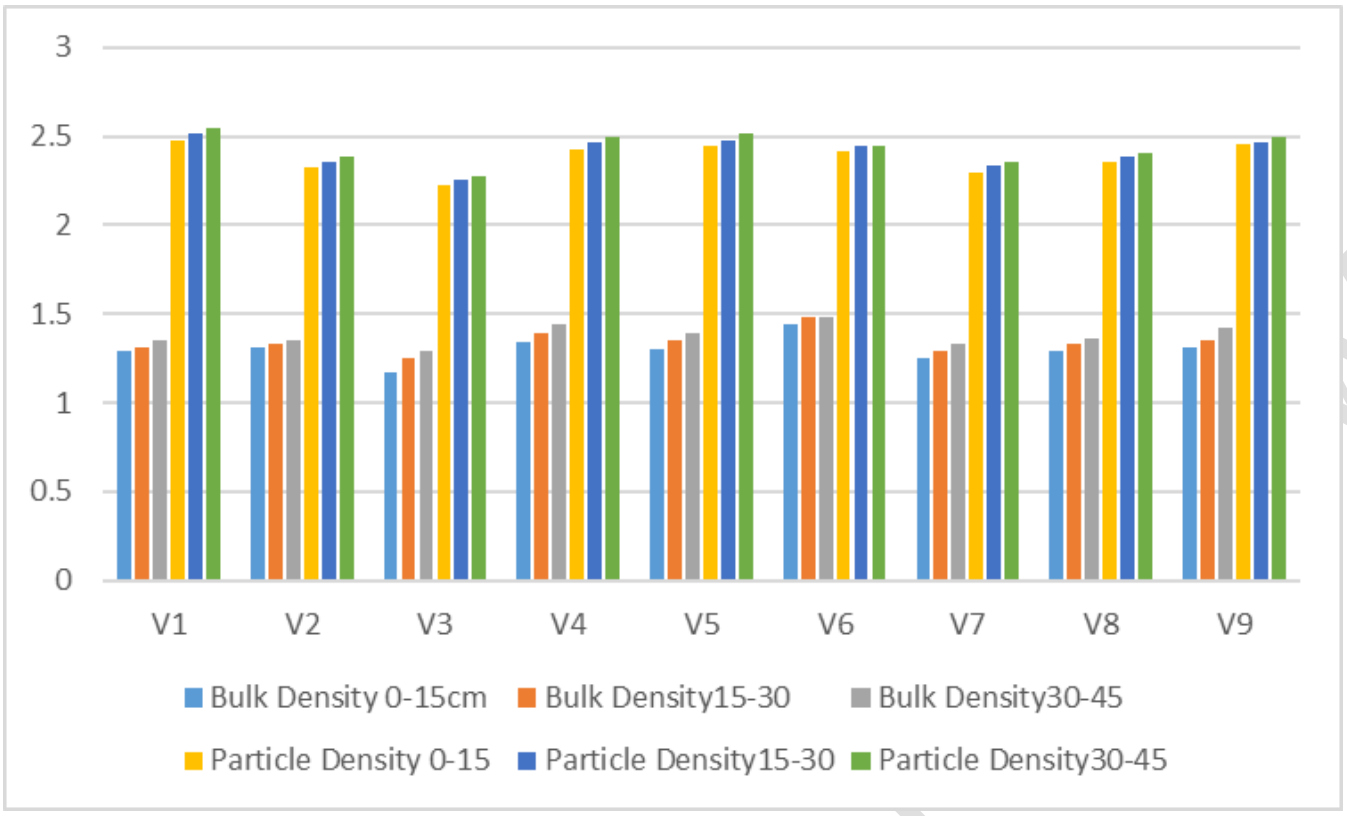

Fig. 1. Bulk density and Particle density (Mg m^{-3})

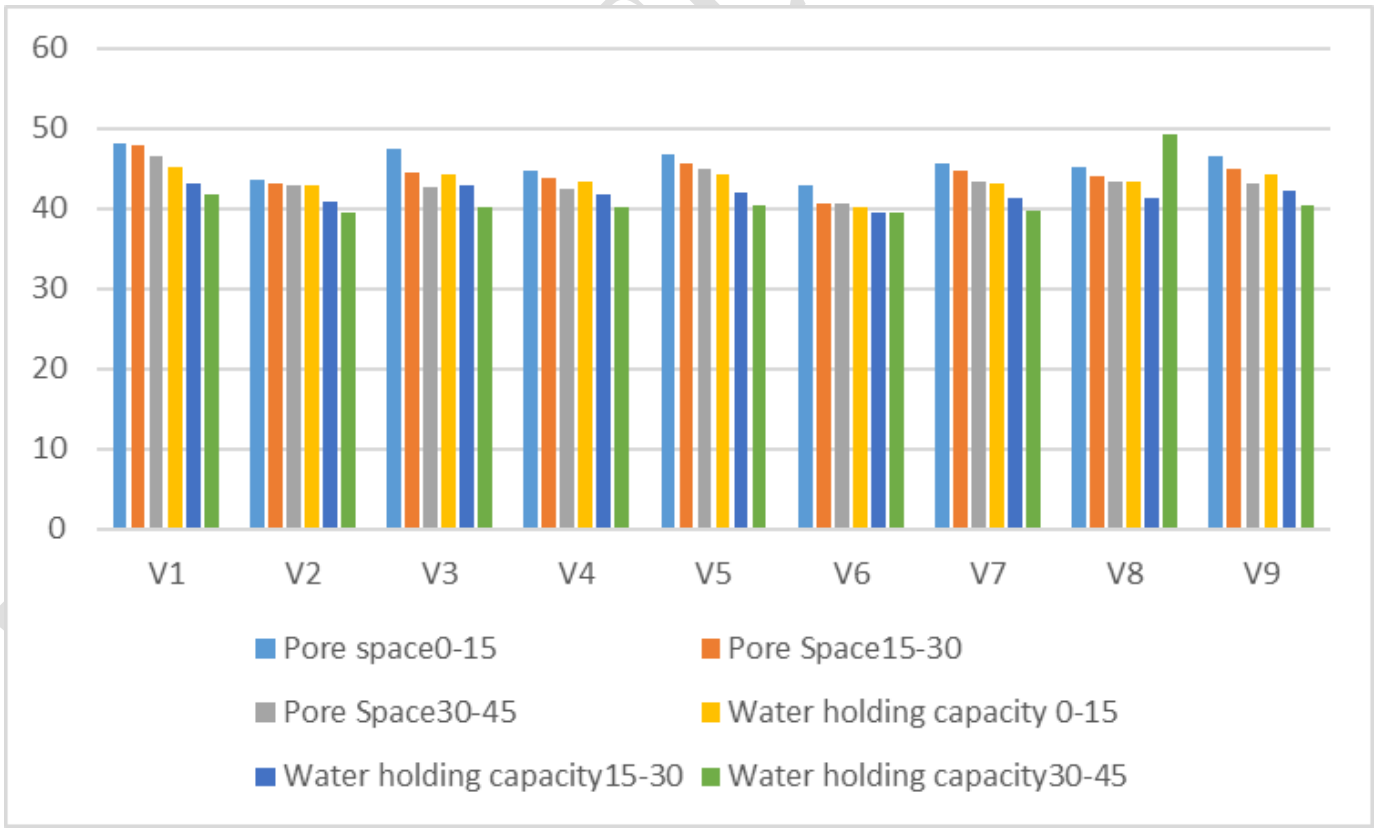

Fig. 2. Pore space and water holding capacity (%)

Soil Chemical Properties

Soil pH

pH of a soil samples ranges from 7.43 – 8.20. The highest pH value was observed in the V_8 - Leduki *i.e.* 8.20 . the lowest pH was found in V_2 – Dewahi *i.e.* 7.43. The results shown the pH is alkaline in nature . The pH is significant and appropriate for the nutrient availability. Similar significant results were reported by **(Ghosh *et al.*, 2021).**

Soil EC (dS m^{-1})

EC in a soil samples ranged from 0.21-0.39 dS m^{-1}. The results were found to be significant. Highest EC content was reported in V_9 - Sirsi *i.e.* 0.39 dS m^{-1} , whereas the lowest EC content was observed in V_3 –Amirati *i.e.* 0.21 dS m^{-1}. Similar results were reported by **(Ghosh *et al.*, 2021).**

4.7 Soil Organic Carbon (%)

Organic carbon soil samples value ranges from 0.21 – 0.38 % The results were found to be significant. Highest organic carbon reported in V2- Dewahi *i.e.* 0.38 %, whereas the lowest organic carbon was observed in V_3 – Amirati *i.e.* 0.21%. The organic carbon is low as there is less vegetation is used as residue and due to tropical climate, degradation is quick in whole block. Similar results were reported by **(Ghosh *et al.*, 2021).**

Table 3. Variation in Soil pH, electric conductivity and organic carbon

S. No.	Soil pH			Soil EC (dS m^{-1})			Soil organic Carbon (%)		
	0-15 cm	15-30 cm	15-45 cm	0-15 cm	15-30 cm	15-45 cm	0-15 cm	15-30 cm	15-45 cm
V_1	7.45	7.50	7.88	0.24	0.28	0.31	0.34	0.30	0.28
V_2	7.43	7.63	7.76	0.26	0.29	0.32	0.38	0.36	0.33
V_3	7.83	7.95	7.95	0.21	0.24	0.26	0.27	0.25	0.22
V_4	8.03	8.15	8.19	0.33	0.35	0.37	0.28	0.26	0.21
V_5	8.06	8.10	8.12	0.33	0.37	0.39	0.29	0.27	0.24
V_6	8.07	8.13	8.16	0.31	0.35	0.35	0.32	0.30	0.28
V_7	8.04	8.10	8.12	0.34	0.35	0.37	0.38	0.36	0.32
V_8	8.15	8.18	8.20	0.22	0.25	0.27	0.33	0.30	0.27
V_9	8.10	8.15	8.15	0.33	0.35	0.39	0.31	0.27	0.24
F- test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
S.Em. (±)	**0.134**	**0.108**	**0.083**	**0.006**	**0.004**	**0.004**	**0.002**	**0.004**	**0.004**
C. D. @ 5 %	**0.399**	**0.322**	**0.234**	**0.018**	**0.014**	**0.14**	**0.008**	**0.013**	**0.012**

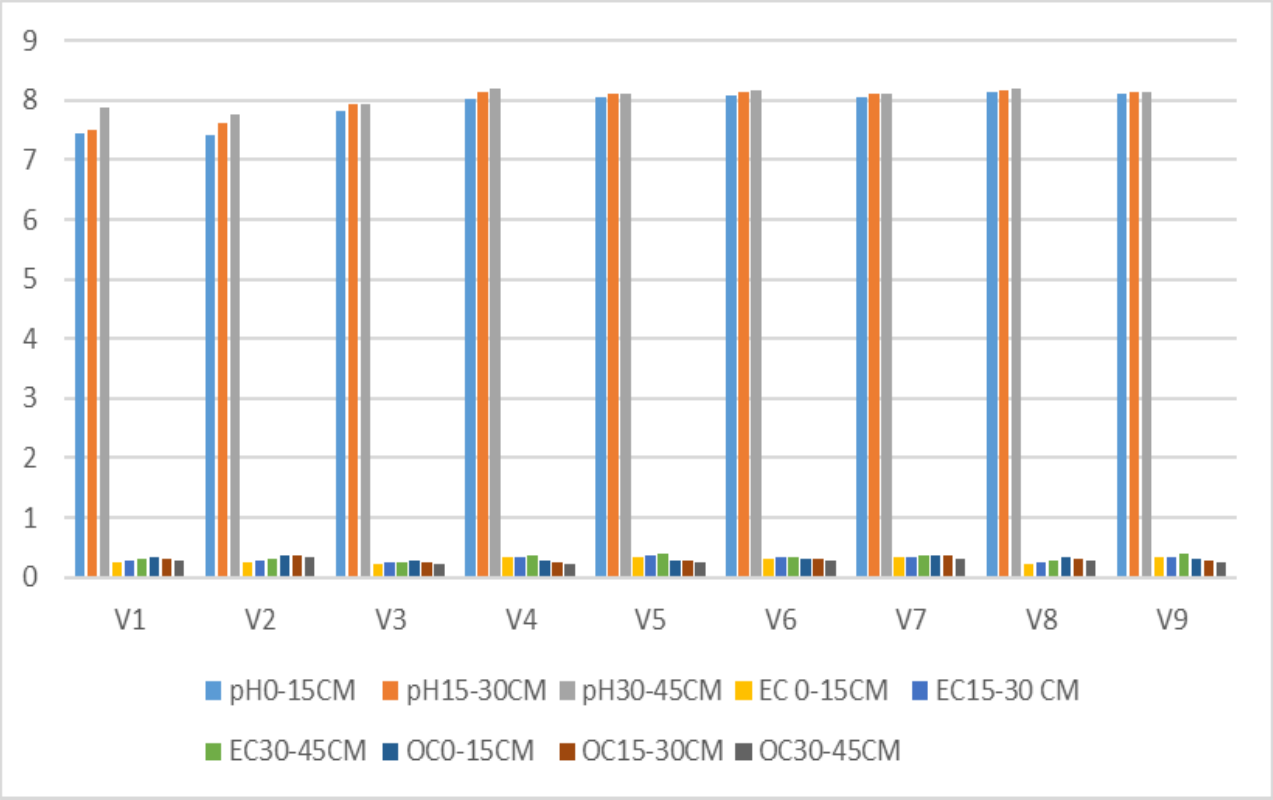

Fig. 3. pH, EC (dS m^{-1}) and Organic Carbon (%)

Soil Nitrogen (kg ha^{-1})

Nitrogen content in soil sample ranges from 160 – 380 kg ha^{-1}. The results were found to be significant. Highest nitrogen content in soil was observed in V_5 - Birshahpur *i.e.*, 380kg ha^{-1} and the lowest nitrogen content was reported in V_1- Aksauli *i.e.* 160 kg ha^{-1}. Similar results were observed **(Ghosh *et al.*, 2021).**

Soil Phosphorus (kg ha^{-1})

Phosphorus in soil samples ranged from 22.53 – 37.49 kg ha^{-1}. The results were found to be significant. Highest phosphorus was reported in V_9 – Ghori *i.e.* 37.49 kg ha^{-1}, whereas the lowest phosphorus content was observed in V_4 - Bhuili *i.e.* 22.53 kg ha^{-1}. Significant results were observed **(Ghosh *et al.*, 2021).**

Soil Potassium (kg ha^{-1})

Potassium content in the soil samples ranges from 105.54 – 282.4kg ha^{-1} The results were found to be significant. Highest potassium content was reported in V_6 –Indi parwatpur *i.e.* 282.4 kg ha^{-1}, whereas the lowest potassium content was observed in V_8 – Leduki *i.e.* 105.54 kg ha^{-1}.. Similar results were observed with **(Ghosh *et al.*, 2021).**

Table 4. Variation in soil nitrogen, phosphorous and potassium

S. No.	Soil Nitrogen (kg ha^{-1})			Soil Phosphorus (kg ha^{-1})			Soil Potassium (kg ha^{-1})		
	0-15 cm	15-30 cm	15-45 cm	0-15 cm	15-30 cm	15-45 cm	0-15 cm	15-30 cm	15-45 cm
V_1	250	205	160	26.22	25.50	24.96	200	180.47	150.32
V_2	344	285	200	24.22	23.33	22.82	156.8	148.32	122.22
V_3	297	232	170	25.95	24.82	24.23	190.4	172.25	140.22
V_4	338	265	195	24.45	23.08	22.53	170	150.45	125.25
V_5	380	320	275	26.76	25.79	24.70	244	222.44	180.44
V_6	350	280	220	26.60	25.64	24.89	282.4	260.22	220
V_7	275	220	160	35.75	34.88	34.33	156.8	140.56	110.55
V_8	280	250	190	36.71	35.20	34.59	148.43	130.44	105.54
V_9	290	210	140	37.49	34.44	32.44	222	185.55	135.52
F- test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
S.Em. (±)	**5.295**	**2.823**	**2.622**	**0.403**	**0.401**	**0.534**	**3.540**	**2.743**	**2.082**
C. D. @ 5 %	**15.732**	**8.388**	**7.792**	**1.198**	**1.193**	**1.587**	**10.519**	**8.151**	**6.186**

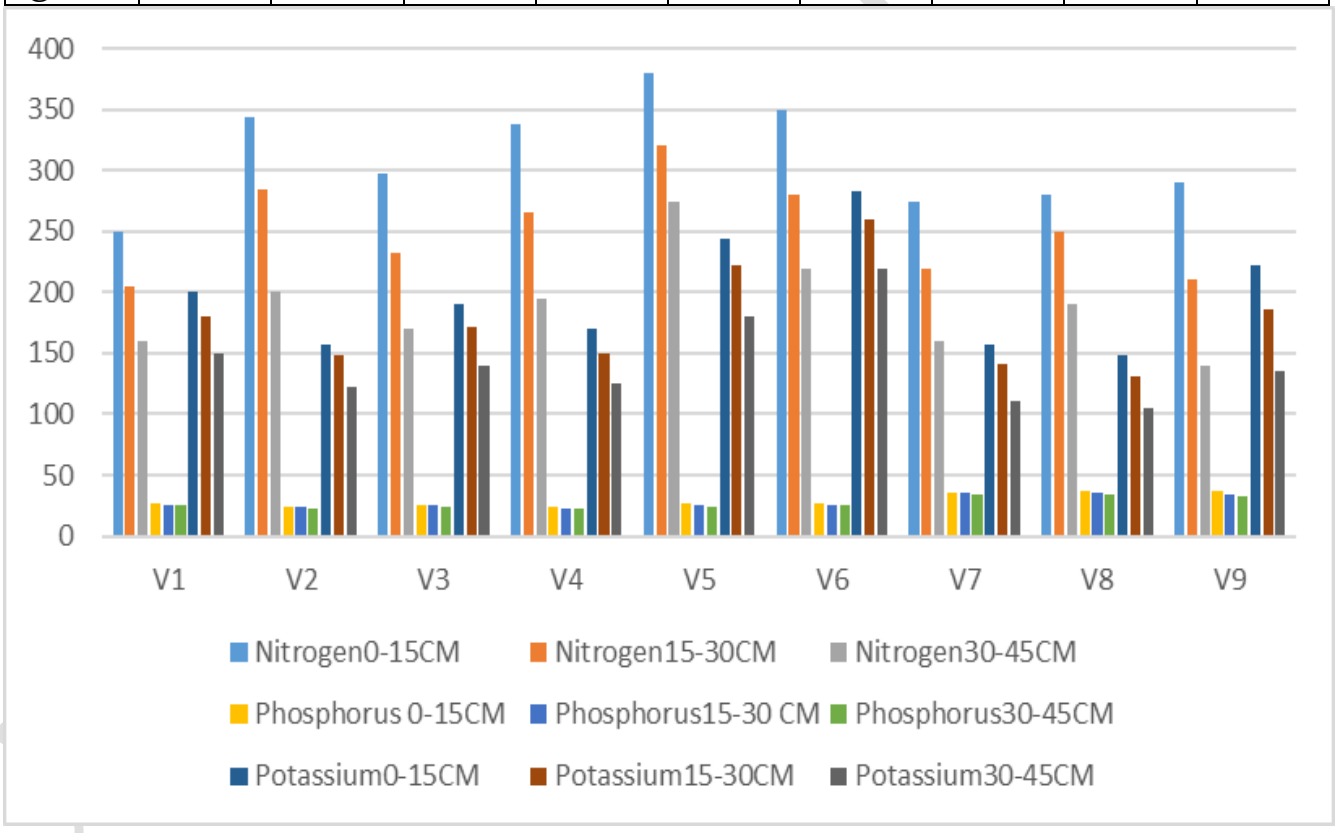

Fig. 4. Available nitrogen, available phosphorous and available potassium (kg ha-1)

CONCLUSION

It can be concluded that the soils of Mirzapur block of Uttar Pradesh are in moderately good physical condition which favors the cultivation of most of the crops, especially rice and wheat. Soil texture showed high sand percentage, pH of soil is alkaline in nature, Electrical conductivity was suitable for all crops, Organic carbon was found low in all the villages, soils have medium Nitrogen in all villages. Phosphorus content was found medium in all villages.. Potassium content was found medium to high in all villages.. The deficiency of nutrients can be mitigated by the use of some inorganic fertilizers or organic fertilizers. Tolerant varieties can be used and Integrated Nutrient Management can be adopted.

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