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The Physicochemical Properties of Mandawar Block, Soil Dausa, Rajasthan, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Analysed at the division of Soil Science and Agricultural Chemistry, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences. The soil texture of the experimental area varied from sandy loam to . In general, the top soil had higher sand fraction then the lower layers. The study revealed that the range of bulk density was varied from 1.32-1.47 Mg m-^{3}, the bulk density was increased with increasing the depth as the compaction increases. The

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range of particle density was from 2.36 to 2.49 Mg m^{-3} and the pore space 37.77 to 44.17 %, respectively. The water retention capacity (WRC) of soil was ranged between 43.56 to 57.28. The pH of soils was in the range between pH 6.67 - 7.75. The electrical conductivity of soil of entire studied area were less than 1.00 dSm^{-1}. The soil organic matter, ranges from 0.13 to 0.38 %. The available nitrogen content of entire studied area was low (162 to 310 kg ha^{-1}). The available phosphorus and potassium content varied in between 15 to 52 kg ha^{-1} and 125 to 255 kg ha^{-1}. The available zinc, copper, manganese and iron of experimental soil ranged between 0.30 to 0.82 mg kg^{-1}, 0.36 to 1.32 mg kg^{-1}, 1.50 to 6.04 mg kg^{-1} and 2.36 to 9.62 mg kg^{-1}. The fertility data base would be very useful for extension functionaries, agricultural officers, scientist and above all the farmers for a sustainable crop production.

Keywords: pH; EC; organic carbon; nitrogen; potassium; phosphorus; Dausa district.

1. INTRODUCTION

"Soil is one of the most important natural resources of any country and it is indispensable for our universe. It nourishes the entire plant kingdom and sustenance human life. Soil is the unconsolidated mineral matter on the earth's surface that has been subjected to and influenced by parent material, climate (including rainfall and temperature), topography, and microorganisms, all acting over a while and producing a product that is soil" [1].

"The growing population of the earth demands a systematic evaluation of soil resources concerning their extent, distribution, characteristics, and use potential, which is very important for developing effective land use planning for augmenting agricultural production on a sustainable basis" [2]. Although soil provides food, fuel, fodder, and fiber the primary essential to sustain life it is a most neglected and misused natural resource.

"Physical properties analysis generally includes simple, fast, and low-cost methodologies. The physical properties of soil that were assessed were bulk density, particle density, porosity, water holding capacity, specific gravity and soil color. The texture describes the proportion of three sizes of the soil particles and the fineness or coarseness of a soul. Soil texture is an important factor affecting the balance between water and gases, but it is very stable over time, independently of the soil management" [3].

"Chemical attributes have been correlated with plant yields and thus the variations of a particular indicator are easily interpreted, and allow a quick improvement of the soil chemical properties by liming and fertilization Soil chemical parameters have been traditionally used for assessment of potentially available nutrients for crops, and are based on worldwide well-established analytical methodologies. The chemical properties that were analyzed were pH, electrical. conductivity, organic carbon, organic matter, Available nitrogen, phosphorus and potassium in secondary nutrients such as sulfur, calcium, and magnesium and heavy metals content, such as zinc, boron, iron, manganese, and copper" [4].

"Micronutrient deficiencies were first reported at the end of the 19th century and today it is well known that the extensive areas of our soils are incapable of supplying plants with sufficient amounts of micronutrients. The application of fertilizer in the soil having only major nutrients, the loss of micronutrients through plant uptake and leaching, the decreasing proportion of farm yard manure and other organic manures in comparison with fertilizers and several other factors collectively contribute towards the deficiency of micronutrients in soils". (Das *et al*., 2009).

"Rajasthan is located in North-western India and is the biggest state in the country and the seventh largest by population. It has an area of 3, 42,239 sq. km encompassing 11% of the total geographical area of India. Rajasthan's area is similar to that of Western countries like Italy (3, 01,200 sq. km), Norway (3, 24,200 sq. km), and Poland (3, 12,600 sq. km). The state was formed on 30 March 1949 when Rajputana – the name adopted by the British Raj for its dependencies in the region was merged into the Dominion of India. Important cities are Jaipur, Dausa, Jodhpur, Kota, Bikaner, Ajmer, Alwar and Udaipur. The states of Haryana, Uttar Pradesh and Punjab bound the state of Rajasthan in the north and northeast. Uttar Pradesh, and Madhya Pradesh lie in the east while the state of Gujrat is located in the southwest of the state" [4].

2. MATERIALS AND METHODS

2.1 Study Area

Dausa is located at 27°8' 41" N 76°50'28" E. The city covers an area of 64 km^2 and lies at an altitude of 467 m (1532 ft.) above sea level. The city lies 54 km west of the state capital, Jaipur. Dausa has a semi-arid climate.

Temperatures vary in different seasons. In the summer (April to June), the average daily temperature was 35^{0}C, while May and June are the hottest months in Dausa and the temperature reaches up to 40-45^{o}C. Annually the rainfall is concentrated in the monsoon months between June (Late June) and September and is estimated over 500 mm (approximately 20 inches). The winter (November to February) is mild and pleasant with average temperatures in the range of 15-18^{0}C and little or no humidity. December and January are the coldest months in Dausa with temperatures varying between 5-10^{o}C. There are however occasional cold waves that lead to temperatures near freezing.

Fig. 1. Geographical maps of the India,state and district
(Soure ; Portial map of India

2.2 Soil Sampling

A total of twenty-seven soil samples were collected from nine different villages of three different blocks of coastal areas, Ganjam district namely Chatrapur, Rangeilunda, and Chikiti. Soil samples were collected from three different depths *i.e.,* 0-15, 15-30, and 30- 45cm with the help of spade and khurpi from crop fields. The samples were air dried in shade and large clods were broken down by using wooden mallet, and separated the larger particles by using a 2 mm IS sieve. After that, soils were collected in polythene bags and labeled properly for further laboratory analysis.

3. RESULTS AND DISCUSSION

3.1 Physical Properties

The textural classification of soil in different villages of Mandawar block. The texture classification of soil samples was observed as Sandy loam in all villages.The maximum bulk density recorded was in both V_6 - Nangal Meo and V_9 -pakher which indicates that the soil is composed of sand and aggregated loams. The minimum bulk density was recorded in V_1 – kot. A similar finding was reported by Sahoo et al., [5] and Pusty and Panda [6]. V_6 – Nangal meo was reported as the highest in particle density followed by V_8 – Reendli, and lowest was found in V_1 – Kot. Similar results were reported byKumar et al. [3]. V_6 – Kot reportedthe highestporosity followed by V_9 – Pakhar, while v_7 – Nangal meo reported the lowest porosity. Significant ($P<0.05$) resultswereobserved byNoman et al. [2]. The highestwater holdingcapacitywas observed in the V_9 – Phakar, whereas the lowestwater holdingcapacitywasobserved in V_1 – kot. Similarresultswerereported by Mahapatra et al., 2019).

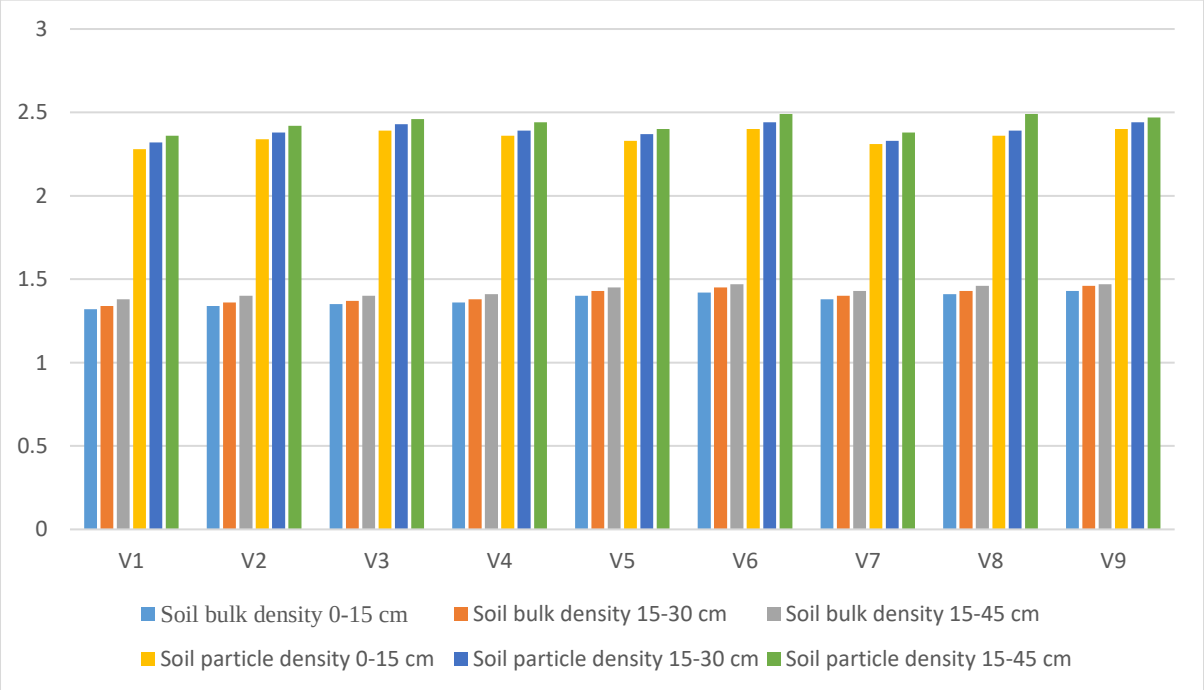

Fig. 2. Bulk density & particle density of soil samples in different villages of the mandawar block

Table 1. Bulk and particle density of the soil samples in different villages of the Mandawar block

S. No.	Soil bulk density			Soil particle density		
	0-15 cm	15-30 cm	15-45 cm	0-15 cm	15-30 cm	15-45 cm
Kot (V_1)	1.32	1.34	1.38	2.28	2.32	2.36
Haldena (V_2)	1.34	1.36	1.4	2.34	2.38	2.42
Banawar (V_3)	1.35	1.37	1.4	2.39	2.43	2.46
Reendli (V_4)	1.36	1.38	1.41	2.36	2.39	2.44

S. No.	Soil bulk density			Soil particle density		
	0-15 cm	15-30 cm	15-45 cm	0-15 cm	15-30 cm	15-45 cm
Garh Himmat singh (V_5)	1.4	1.43	1.45	2.33	2.37	2.40
Hadoli (V_6)	1.42	1.45	1.47	2.40	2.44	2.49
Muna pura (V_7)	1.38	1.4	1.43	2.31	2.33	2.38
Nangal meo (V_8)	1.41	1.43	1.46	2.36	2.39	2.49
Pakhar (V_9)	1.43	1.46	1.47	2.40	2.44	2.47
F- test	NS	NS	NS	NS	NS	NS
S.Em. (±)	-	-	-	-	-	-
C. D. @ 5 %	-	-	-	-	-	-

Table 2. Soil porosity and water holding capacity of the soil samples in different villages of the Mandawar block

S. No.	Soil porosity			Soil water holding capacity		
	0-15 cm	15-30 cm	15-45 cm	0-15 cm	15-30 cm	15-45 cm
Kot (V_1)	44.17	41.86	38.52	41.34	39.60	36.88
Haldena (V_2)	42.35	40.55	39.77	40.55	38.54	39.19
Banawar (V_3)	41.42	39.49	38.13	38.88	36.15	39.59
Reendli (V_4)	43.49	41.42	40.04	39.56	38.67	39.72
Garh Himmat singh (V_5)	43.84	40.36	37.67	40.75	36.87	39.63
Hadoli (V_6)	40.52	38.23	36.29	38.65	35.58	40.26
Muna pura (V_7)	41.00	37.17	35.23	37.55	34.23	39.45
Nangal meo (V_8)	43.98	41.52	39.24	41.54	38.38	39.23
Pakhar (V_9)	44.09	41.56	37.23	42.54	37.97	38.68
F- test	S	S	S	S	S	S
S.Em. (±)	0.45	0.62	0.75	0.5	0.59	0.58
C. D. @ 5 %	0.092	0.053	0.045	1.5	2.46	2.32

3.2 Soil Chemical Properties

The highest pHvalue was observed in the V_4 – Manipura followed by V_6 – Nangal meo and the lowest pH was found in V_5 – Hadoli. The results revealed that the pH was in the neutralrange. The pH is significant and appropriate for nutrient availability. Similar significantresultswere reported byBasavarajaet al. [7]. EC in soil samples was significant. The highest EC content was reported in V_1 – Kot followed by V_2 – Kolar whereas the lowest was observed in V_9 – Phake. Similar results werereported bySheeba etal., [8]. Organic carbon in soil samples value was significant and the highest organic carbon was reported in V_5 – Hadoli, whereas the lowest organic carbon was observed in V_9 – Pakher. The organic carbon is low as there is less vegetation used as residue and due to the tropical climate, degradation is quick in whole block. Similar resultswerereported byDash et al., [9]. “Nitrogen content in soil samples was significant and the highest nitrogen content in soil was observed in V_7 - Munapura, the lowest nitrogen content was reported in V_8 – Nangal”. [10] Similarresults wereobservedwithSheebaet al.,[8]. Phosphorus in soil samples was significant. The highest phosphorus was reported in V_1 – Kot, whereas thelowest phosphorus content was observed in V_4 - Munapura. Significant resultswereobserved[11]. “Potassium content in the soil samples was significant. The highest potassium content was reported in V_3 - Banawar, whereas the lowest potassium content was observed in V_8 – Reendli. The status of potassium was found moderate in the whole region due to alluvial soil which is moderate to high in available potassium”. [12-13] Similar results wereobserved with (Mahapatra et al., 2019).

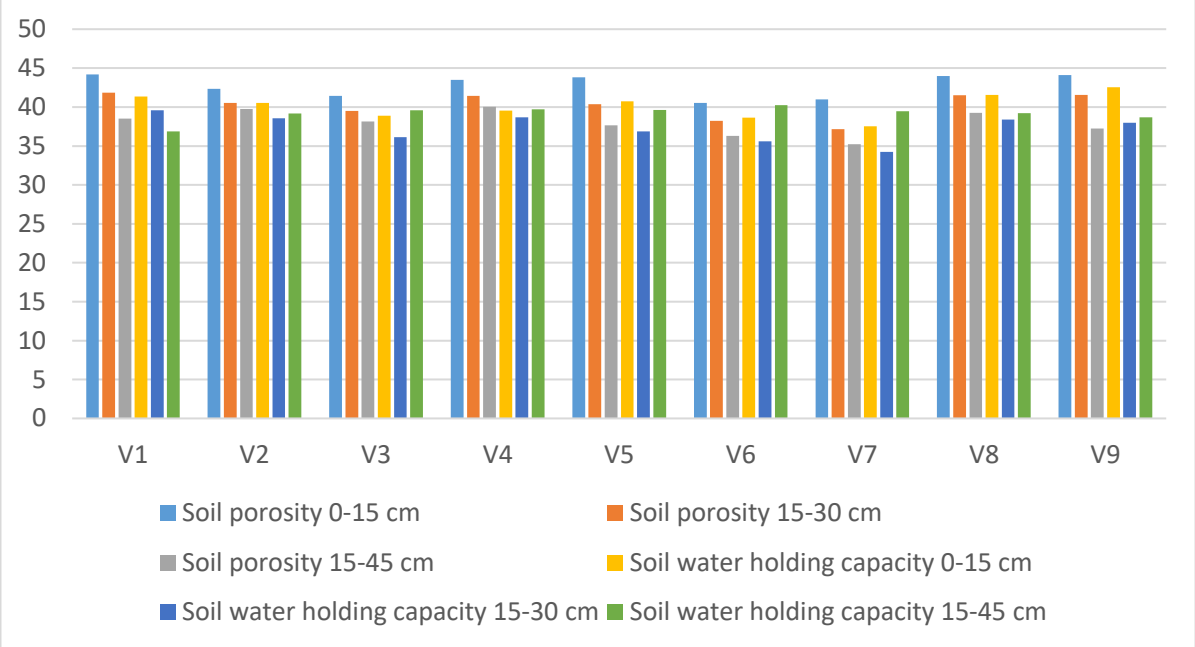

Fig. 3. Soil porosity and water holding capacity of the soil samples in different villages of the Mandawar block

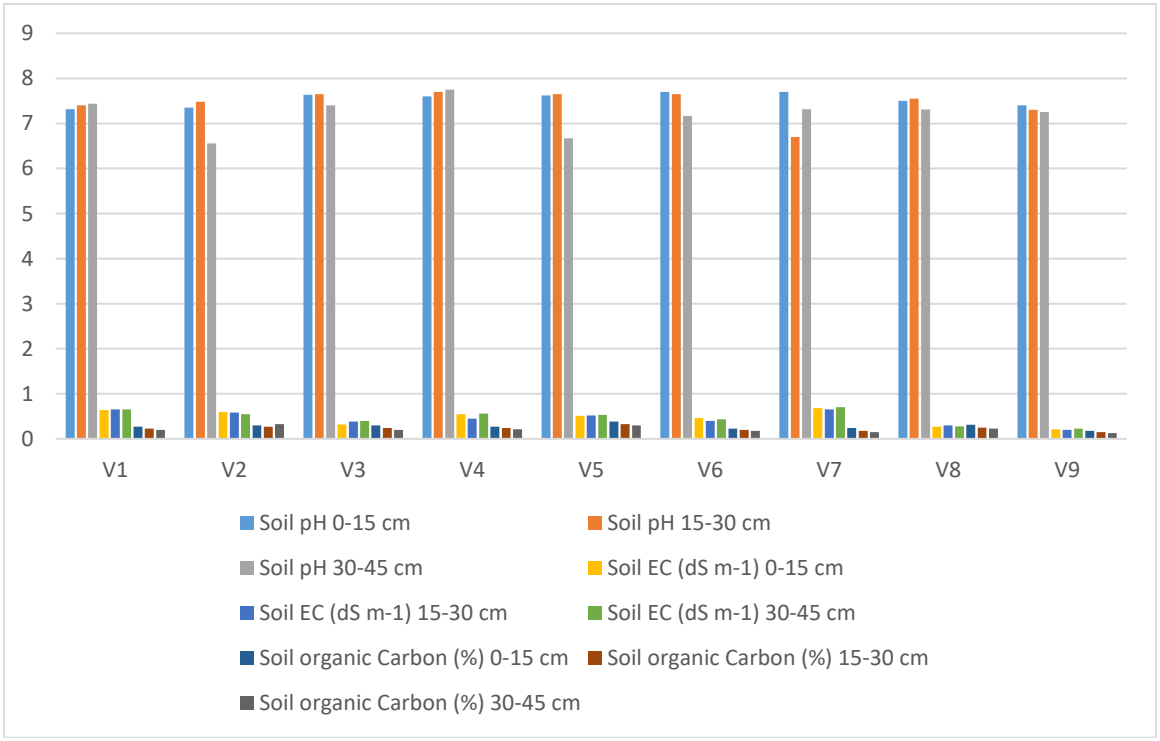

Fig 4 Soil pH, EC, and Organic carbon of the soil samples in different villages of the Mandawar block

Table 3. Soil pH, EC, and Organic carbon of the soil samples in different villages of the mandawar block

S. No.	pH			EC (dS m^{-1})			Oraganic carbon (%)		
	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
Kot (V_1)	7.32	7.40	7.44	0.64	0.65	0.65	0.27	0.23	0.20
Haldena (V_2)	7.35	7.48	6.56	0.60	0.58	0.55	0.30	0.27	0.33
Banawar (V_3)	7.64	7.65	7.40	0.32	0.38	0.40	0.30	0.24	0.20
Reendli (V_4)	7.60	7.70	7.75	0.55	0.45	0.56	0.27	0.24	0.21
Garh Himmat singh (V_5)	7.62	7.65	6.67	0.51	0.52	0.53	0.38	0.33	0.30
Hadoli (V_6)	7.70	7.65	7.17	0.46	0.40	0.43	0.23	0.20	0.18
Muna pura (V_7)	7.70	6.70	7.32	0.68	0.65	0.70	0.24	0.18	0.15
Nangal meo (V_8)	7.50	7.55	7.31	0.27	0.30	0.28	0.31	0.25	0.23
Pakhar (V_9)	7.40	7.30	7.25	0.21	0.20	0.23	0.18	0.15	0.13
F- test	S	S	S	S	S	S	S	S	S
S.Em. (±)	0.13	0.09	0.12	0.005	0.005	0.003	0.003	0.003	0.002
C. D. @ 5 %	0.39	0.28	0.37	0.001	0.001	0.001	0.01	0.01	0.006

Table 4. Available nitrogen, phosphorus, and potassium of the soil samples in different villages of the mandawar block

S. No.	Soil Nitrogen (kg ha^{-1})			Soil Phosphorus (kg ha^{-1})			Soil Potassium (kg ha^{-1})		
	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
Kot (V_1)	264	223	196	52	48	44	168	145	140
Haldena (V_2)	290	250	218	50	45	42	144	135	130
Banawar (V_3)	275	225	206	52	50	48	243	235	255
Reendli (V_4)	272	245	212	20	18	15	296	278	250
Garh Himmat singh (V_5)	255	205	186	37	34	30	188	170	158
Hadoli (V_6)	240	198	179	33	30	28	201	185	175
Muna pura (V_7)	310	242	221	35	31	27	211	205	180
Nangal meo (V_8)	234	186	162	24	22	20	145	128	125
Pakhar (V_9)	260	213	177	45	40	37	223	215	205

S. No.	Soil Nitrogen (kg ha^{-1})			Soil Phosphorus (kg ha^{-1})			Soil Potassium (kg ha^{-1})		
	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
F- test	S	S	S	S	S	S	S	S	S
S.Em. (±)	4.08	2.98	2.69	0.29	0.32	0.24	4.05	3.17	2.64

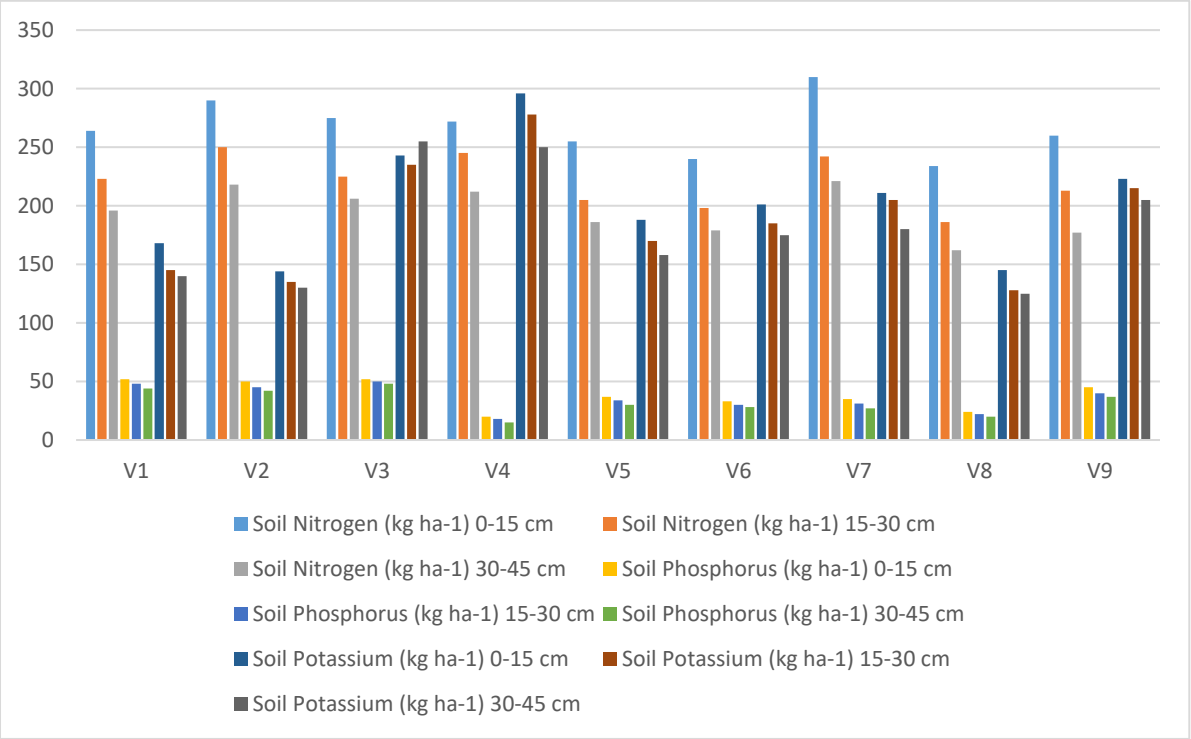

Fig. 5. Available nitrogen, phosphorus, and potassium of the soil samples in different villages of the Mandawar block

4. CONCLUSION

The majority of crops, particularly wheat and maize, may be grown in the Mandawar block of Dausa, Rajasthan, due to the soils' good physical condition. The soil's texture revealed a high percentage of clay, a pH that was neutral, very little to no organic carbon content, and low to medium levels of NPK. The application of certain inorganic or organic fertilizers can help to lessen the lack of nutrients. It is possible to employ tolerable cultivars and implement integrated nutrient management.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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