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Assessment of physico-chemical properties of different villages of Deegh block of Sant Ravidas Nagar Bhadohi District, Uttar Pradesh

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Abstract
During 2023-24, the experiment was conducted to evaluate the physical and chemical characteristics of the soil in the Deegh Block of the Bhadohi District in Uttar Pradesh. Using a khurpi and conventional method, soil samples were taken at depths of 015 and 15-30 cm from the following Deegh block villages: Arata (V_1), Ojhapur (V_2), Nagardha (V_3), Mahuari (V_4), Mailauna (V_5), Tulsipatti (V_6), Suryabhanpur (V_7), Holpur (V_8), and Dhanapur (V_9).
The Department of Soil Science & Agricultural Chemistry, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj-211 007 (U.P.) is the laboratory where the physical and chemical properties of soil were analysed. After examining the soil's physical characteristics, the texture of the soil was discovered. Clay loam and soil colour vary from light brown to brown when dry and from brown to dark brown when wet. The soils' particle densities ranged from 2.20 to 2.56 mg m^{-3}, while their bulk densities varied from 1.00 to 1.42 mg m^{-3}. Soils varied in their percentage of pore space (42.89% to 49.26%) and water-holding capacity (38.6 to 44.26%). With a soil EC of less than 0.47 dSm^{-1}, the pH of the soil ranges from 7.04 to 7.70, which is neutral to slightly saline. In the case of the organic carbon, nitrogen and phosphorus content of research area was found low to medium while the range of Potassium was sufficient ranges from 77.82 to 183.27 kg ha^{-1}. Exchangeable Calcium and magnesium were also present there.

Keywords: Soil health, Deegh block, Bhadohi district physico-chemical properties, texture, etc.

Introduction
The word "soil," which comes from L. Solum, has a variety of meanings. According to plant growth, soil is a collection of organic and mineral particles that vary in size and composition. Additionally, soil is loose material on the surface of the planet that has been impacted throughout time by various environmental and genetic factors, including terrain, climate, creatures, and parent material. For a farmer, "soil" refers exclusively to the surface soil, or the farmed top layer, which typically extends up to 15-20 cm below the plough depth. It serves as the medium via which plants absorb water and minerals. In addition, soil gives physical support to all living things, including humans and the buildings they built. Soil science is the study of various soil types and their characteristics.
Pedology: This field of study focuses on the origins, categorization, and description of soil. A pedologist views soil as a natural entity and is not primarily concerned with its immediate practical use. Pedologists investigate, analyse, and categorise soil in its native habitat.
Edaphology is the study of soils as seen through the eyes of higher plant life. It takes into account different soil characteristics and how they affect plant growth. The ultimate goal of the pragmatic edaphologist is the creation of food and fibre. In order to determine the cause of variations in soil productivity and to establish strategies for preserving and enhancing soil productivity, edaphologists also need to possess scientific knowledge.
All soils have different properties and working with them requires an understanding of these properties. Knowledge of the physical and chemical properties of soils helps in managing

resources while working with a particular soil. They need to be studied for agricultural purposes, to increase productivity, and to improve the workability of soil mass. The study of the up-to-date status of soil properties is a very important tool to enhance production on a sustainable basis (Tewari *et al*., 2016) [16]. The most important and valuable natural resource that supports all types of living systems and socioeconomic development in any nation on Earth is soil, when used properly.

Physico-chemical characteristics of different soils vary in space and time due to variation in topography, climate, physical weathering processes, vegetation cover, microbial activities and several other biotic and abiotic variables. Soil is a dynamic, natural body that occurs on the earth's surface which supports the growth of plants. Soils are formed by the decomposition of rock and organic matter over many years (Zaware, 2014) [21]. The most important stage in any soil analysis is soil sampling. It is a dynamic natural body that was created when rocks weathered due to pedogenic processes. In its traditional sense, it refers to the organic substrate that terrestrial plants grow in. Soil is made up of both organic and mineral components, and it has distinct physical, chemical, and biological characteristics that vary in depth. The earth's surface offers a good growing substrate for plants. Soil is mostly made up of 50% solid phase and 50% pore space, which includes both water and air. The soil phase is mostly made up of 5% organic matter and 45% mineral stuff. All of the unconsolidated crustal material that makes up soil is where plants grow when the temperature and water levels are right, at least minimally nutrient-rich, and the concentration of harmful elements is low.

Fertiliser studies are being developed to identify the economically optimal rates of fertiliser application. Soil testing provides a comprehensive means of controlling nutrients. Modern farming demands high yields at low costs per unit of production. Today's farmers are different in that they have to deal with more predictable and early failure unless they are achieving respectably high yields. Better drainage, several enhanced cultural methods, better varieties, and the management of pests and diseases have all contributed to the production of high yields. Consequently, the soil's need has progressively increased. Farmers may ensure that their efforts in other enhanced practices will provide returns by applying fertiliser in the right amounts and types thanks to soil testing (USDA, 2016).

Soil health is defined as the continued capacity of soil to function as a vital living ecosystem that sustain plants, animals, and humans. Creating and maintaining a healthy soil is more than just reducing erosion. The benefits of a healthy soil go far beyond crop production.

Improvements in SH via good management can promote crop yields in systems. Where nutrients or water are limiting via increased nutrient cycling, nutrient availability. And/or water capture (Foley *et al*. 2011) [7]. SHC scheme launched in February 2015 to issue soil health card to farmer under the scheme. SHC is a complete evaluation of the quality of soil right from its functional characteristics to water and nutrient content and other biological properties. It includes corrective measure that a farmer should adopt to obtain a better yield. The SHC helps the farmers to get crop -wise recommendation of nutrient and fertilizer required in each type of soil and this lead improve soil health under the expert guidance. (Singh *et al*. 2020) [22].

Given the significance of soil's physical and chemical characteristics, a study was conducted to examine the physico-chemical characteristics of soil that was collected from different areas in the Bhadohi district of Uttar Pradesh. Nine villages in the Deegh block of the Bhadohi District in the state of Uttar Pradesh provided soil samples for the study. Using a soil auger and khurpi or knife, samples were randomly taken using the composite sampling method at three different depths: 0-15 cm, 15-30 cm, and 30-45 cm. By contrasting the findings of the current study with those of past research conducted in the other regions of the state, an analysis of the physico-chemical characteristics of some of the soils in various Uttar Pradesh regions has been conducted. Therefore, in order to successfully implement the idea of physico-chemical analysis, a thorough investigation for the evaluation of soils is required. A study on soil has been conducted with the following goal in mind.

Materials and Methods

The current study, "Assessment of physico-chemical properties of soil from different villages of Deegh block of Sant Ravidas Nagar Bhadohi district, Uttar Pradesh," was conducted in 2023-2024 and involved a lab experiment conducted at Sam Higginbottom University of Agriculture, Technology and Sciences, (UP) India's Department of Soil Science. The Uttar Pradesh state's Bhadohi district is located in northern India, between 25.3264°N and 82.4319°E. Another name for it is Sant Ravidas Nagar. In terms of land, it is the state of Uttar Pradesh's smallest district. The city is located 82 km east of Allahabad (now Prayagraj) and 45 km west of Varanasi. Gyanpur is the location of its district headquarters. Being one of the biggest hubs for the carpet industry in India, the district is well-known for its carpet weaving and is sometimes referred to as the "Carpet City of India." The 'Geographical Indication' marking is affixed to Bhadohi carpets. Because of its placement between two culturally significant and rich historical sites, Bhadohi has enormous geographic value and importance. The Ganges River forms the district's southwest boundary, and this district is located on its plains. The districts of Varanasi to the east, Jaunpur to the north, Mirzapur to the south, and Prayagraj to the west encircle the district. Bhadohi is the smallest district in terms of area in Uttar Pradesh, covering an area of 1055.99 km². This district is divided into three tehsils, Aurai tehsil, Bhadohi and Gyanpur, and six blocks, Bhadohi, Suriyawan, Gyanpur, Deegh, Abholi and Aurai.

Summers in Bhadohi are hot and Mediterranean in climate. The district experiences 31.14 °C (88.05°F) annually, which is 5.17% hotter than the national average for India. Approximately 67.75 mm (2.67 inches) of precipitation and 80.17 rainy days (21.96% of the time) are experienced annually in Bhadohi.

In the process of sample collection, twenty-seven soil sample collected from nine villages of Deegh block at various depth of 0-15, 15-30, and 30-45 cm. Sample collected through V- shaped technique by the help of khurpi. The large clods were crushed by wooden mallet and then we sun dried. Sample went through sieving process through 2mm sieve. After sieving we collected these sample in polythene bag and take sample in lab for physico- chemical analysis with proper labelling on sample. In physico -chemical analysis texture class of soil analyzed through Bouyoucos hydrometer (Bouyoucos, 1927) [3], the bulk density and particle density determined by the 100 ml measuring cylinder method (Muthuvel *et al*., 1992) [12]. As in chemical analysis the pH meter was to make 1:2 water suspension (Jackson, 1958) [8] and the EC meter with 1:2 water suspension measured EC of soil sample (Wilcox, 1950) [20]. The organic carbon determined the wet oxidation method (Walkley and Black, 1947) [19], Nitrogen measured by 800ml kjeldhal flask method (Subbiah and Asija, 1956) [15], the colorimetric method (Olsen *et al*., 1954) [13] determined the available phosphorus in sample and available potassium determined by using flame photometer (Tooth and Prince, 1949) [17]

Results and Discussion
Soil Physical Properties
Throughout the inquiry, all of the parameters' data were collected, and for the purpose of drawing reliable conclusions, statistical analysis was performed. This chapter presents a critical analysis and presentation of the findings and debates from the study "Assessment of Physicochemical Properties of Soil Collected from Different Village, Deegh Block, Bhadohi district, Uttar Pradesh, India." When it is thought necessary to explain the results, figures are also used to depict the parameters. The district's soil texture is primarily clay loam, with the largest percentage of sand (36.80%) found in the villages of Holpur and Nagardha (V_8 & V_3) and the lowest percentage (29.20%) found in Mahuari (V_4). The silt percentage ranges from lowest (21.20) in village Tulsipatti & Suryabhanpur (V_6 & V_7) to highest (29.40) in village Arata (V_1). Village Mahuari (V_4) had the highest percentage of clay (44.80), while village Dhanapur (V_9) had the lowest percentage (40.00). The similar finding reported by Behera *et al*., (2016) [2]. The soil in V_4- Mahauri is made up of aggregated loams and sand, as evidenced by the greatest bulk density of 1.38 mg m-3 that was observed. V_8-Holpur had the lowest bulk density reported, 1.00 mg m-^{3}, indicating that aggregated loams and clay make up the majority of the soil reported by Ahad *et al*., (2015) [1]. The maximum soil particle density of 2.56 Mg m-^{3} was found at V_7-Suryabhanpur and village and the minimum soil particle density of 2.20 Mg m-3 was found at V_8- Holpur village. Similar finding reported by Chaudhari *et al*., (2013) [5]. Percentage of soil pore space of different villages varied between 42.89 to 49.26%. The highest soil pore space was found at V_6 - Tulsipatti (49.26%) and lowest soil pore space was found at V_9- Dhanapur (42.89%). Similar findings have also been reported by Prusty & Panda (2019) [14]. The percentage of each village's soil that could hold water ranged from 38.68% to 44.26%. Clay, silt, and the amount of organic carbon in the soils were the causes of these variances. Jena *et al*., (2018) have also published findings that are similar.

Table 1: Bulk density & Particle density (Mg m^{-3})

Sampling Site	Sand %	Silt %	Clay %	Textural Class
V_1	30.40	29.40	40.20	Clay Loam
V_2	34.50	24.70	40.80	Clay Loam
V_3	36.80	22.70	40.50	Clay Loam
V_4	29.20	26.00	44.80	Clay Loam
V_5	33.00	26.70	40.30	Clay Loam
V_6	36.20	21.20	42.60	Clay Loam
V_7	34.80	21.20	44.00	Clay Loam
V_8	36.80	22.70	40.50	Clay Loam
V_9	36.00	24.00	40.00	Clay Loam

Table 2: Pore Space (%) & Water Holding Capacity (%)

Block	BD (Mg m^{-3})		PD (Mg m^{-3})		Pore space (%)		WHC (%)	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean
V_1	1.08-1.20	1.13	2.33-2.45	2.38	48.88-44.32	46.4	44.26-40.18	42.3
V_2	1.02-1.14	1.09	2.30-2.39	2.35	47.72-43.25	45.17	42.34-39.19	41.03
V_3	1.00-1.18	1.08	2.22-2.29	2.25	46.59-43.75	45.16	42.19-39.59	41.05
V_4	1.34-1.42	1.38	2.22-2.36	2.28	47.56-43.96	45.89	42.48-39.72	41.38
V_5	1.29-1.38	1.33	2.28-2.33	2.31	48.76-43.25	45.92	42.46-39.63	41.14
V_6	1.10-1.25	1.22	2.48-2.55	2.51	49.26-44.75	47.12	44.14-40.26	42.66
V_7	1.05-1.11	1.08	2.48-2.56	2.53	48.15-43.81	46.17	44.25-39.45	41.97
V_8	1.00-1.21	1.1	2.20-2.33	2.27	49.09-44.62	47.1	44.17-39.23	42.26
V_9	1.11-1.29	1.19	2.38-2.52	2.44	47.14-42.89	45.26	43.29-38.68	41.31

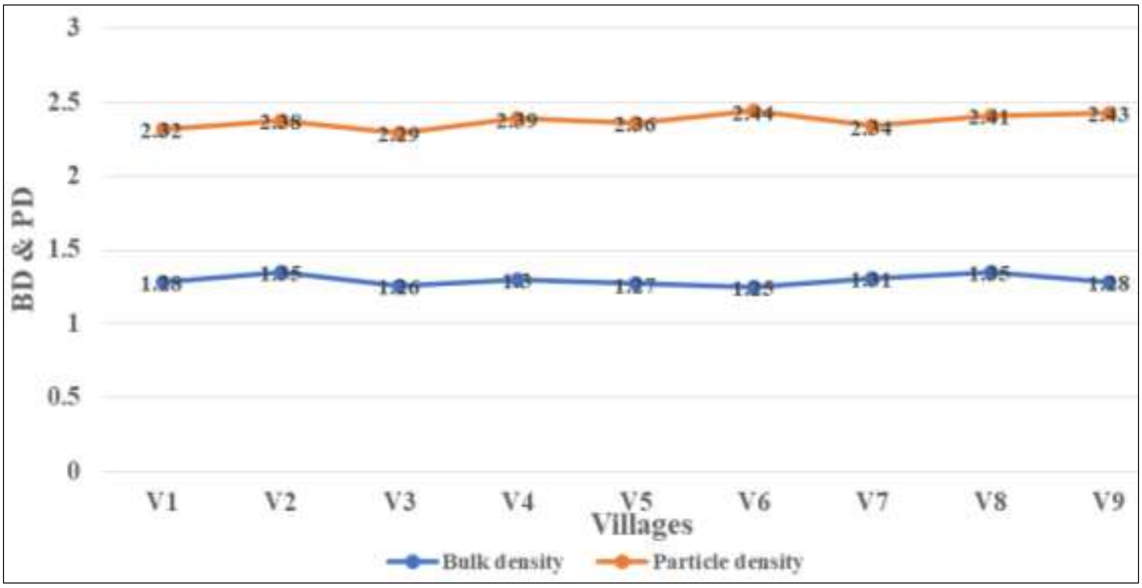

Fig 1: Bulk density & Particle density (Mg m^{-3})

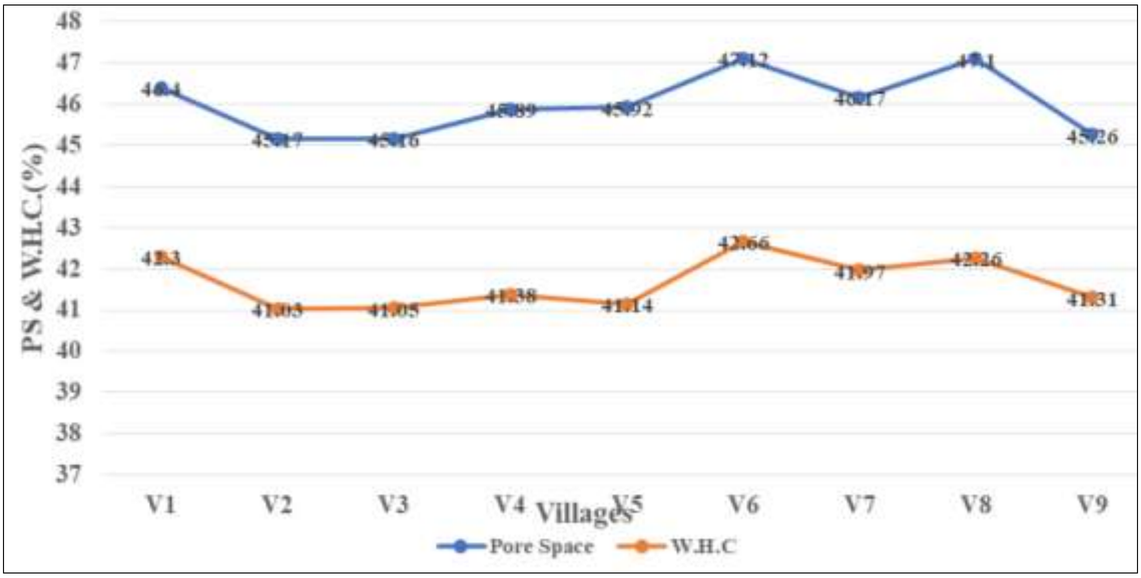

Fig 2: Pore Space (%) & Water Holding Capacity (%)

Soil Chemical Properties

The pH of the soil in various communities ranged from 7.04 to 7.70. The villages of V1 and Arata had the highest soil pH of 7.70, while V7 and Suryabhanpur had the lowest mean soil pH of 7.04. Similar finding reported by Mishra *et al*., (2017) [10]. As in this pH increases with depth due to accumulation of salt and it also affect the EC whereas EC also increses with depth. Various villages have varying soil EC values, ranging from 0.31 to 0.47 dS m^{-1}. At V1 Arata village the soil EC was found to be the highest at 0.47 dS m^{-1}, while at V7Suryabhanpur village it was the lowest at 0.31 dS m^{-1} here we found soil slightly saline to moderately saline. Similar result reported by Upadhyay and Chawla (2014) [48] %. The organic carbon content of the soil varied from 0.15 to 0.44 in different settlements. V4's Mahuari village had the highest soil organic carbon content, measuring 0.44, while V3's Nagardha village had the lowest, measuring 0.15. Dash *et al*. (2016) [6] have also reported similar findings. The organic carbon decreases with depth because it is accumulated on surface layer and it also affect the nitrogen content in soil by increasing it. The available nitrogen ranges from from 143.65 to 290.80 (kg ha^{-1}). The maximum value found is 290.80 (kg ha^{-1}) in V_4 - Mahuari at 0-15cm depth and the minimum value found is 143.65 (kg ha^{-1}) in V_7 - Suryabhanpur at 30-45cm depth. Nitrogen gets affected by external application of fertilizer during crop cultivation. As the soil available phosphorus of different villages varied between 13.39 to 32.28 (kg ha^{-1}). The maximum soil available phosphorus of 32.28 (kg ha^{-1}) was found at V_5- Mailauna, the minimum soil available phosphorus of 13.39 (kg ha^{-1}) was found at V_7- Suryabhanpur village. As the available phosphorus concentration highly available in surface layer which can be fluctuated by depth of soil due to external application of fertilizer during crop cultivation and free iron oxide and Al^{3+} in trace level. Similar outcome showed by Mohapatrra *et al*., (2020) [11]. The soil potassium of different villages varied between 125 to 243 (kg ha^{-1}). The maximum soil potassium of 243 (kg ha^{-1}) was found at V_3-Nagardha village and the minimum soil potassium of 125 (kg ha^{-1}) was found at V_8-Holpur village. The available K gets affected due to many contributing factors may include more intense weathering, the removal of relevant K from organic residue, the application of fertiliser, and the upward transfer of K from a deeper level along the capillary rise of ground water. Similar finding reported by Mohapatra *et al*., (2020) [11]. The exchangeable calcium of different villages varied between 2.8 to 4.8 [cmol (P^+) kg^{-1}]. The maximum exchangeable calcium of 4.8 [cmol (P^+) kg^{-1}] was found at V_8-Holpur village and the minimum exchangeable calcium of 2.8 [cmol (P^+) kg^{-1}] was found at V_3 - Nagardha village and the exchangeable magnesium of different villages varied between 1.29 to 2.49 [cmol (P^+) kg^{-1}]. The maximum exchangeable magnesium of 2.49 [cmol (P^+) kg^{-1}] was found at V_5-Mailauna village and the minimum exchangeable magnesium of 1.29 [cmol (P^+) kg^{-1}] was found at V_1-Ararta village. Both calcium and magnesium availability increase the pH of the soil. Joshi *et al*., (2013) [9] reported similar outcomes.

Table 3: pH, EC (dS m^{-1}) & OC (%)

Block	pH		EC ((dSm $^{-1}$)		OC (%)	
	Range	Mean	Range	Mean	Range	Mean
V_1	7.64-7.70	7.66	0.45-0.47	0.46	0.32-0.24	0.28
V_2	7.16-7.28	7.22	0.34-0.37	0.35	0.34-0.27	0.3
V_3	7.32-7.64	7.49	0.38-0.45	0.42	0.21-0.27	0.17
V_4	7.40-7.56	7.49	0.40-0.44	0.41	0.44-0.40	0.42
V_5	7.32-7.40	7.35	0.38-0.40	0.39	0.27-0.24	0.25
V_6	7.24-7.34	7.3	0.36-0.39	0.37	0.31-0.28	0.29
V_7	7.04-7.28	7.14	0.31-0.37	0.33	0.23-0.20	0.21
V_8	7.48-7.60	7.54	0.42-0.45	0.43	0.25-0.19	0.21
V_9	7.40-7.48	7.43	0.40-0.42	0.41	0.23-0.20	0.21

Table 4: Available Nitrogen, Phosphorus & Potassium (kg h^{-1})

Block	Nitrogen (kg h^{-1})		Phosphorus (kg h^{-1})		Potassium (kg h^{-1})	
	Range	Mean	Range	Mean	Range	Mean
V_1	234.52-203.30	219.76	18-13.72	15.5	168-140	151
V_2	270.38-242.14	255.77	22.56-13.52	17.98	144-130	136.33
V_3	254.41-162.02	208.59	18.25-10.36	14.06	243-225	234.33
V_4	290.80-223.56	256.29	22.32-15.67	18.96	225-198	211
V_5	245.85-189.63	212.91	32.28-24.63	28.91	188-158	1722
V_6	285.54-201.58	243.16	20.65-15.26	18.51	201-175	187
V_7	232.00-143.65	186.53	19.00-13.39	16.24	211-180	198.66
V_8	240.58-188.12	215.45	21.20-14.98	17.83	145-125	132.66
V_9	222.14-153.52	190.14	19.00-14.89	17.17	223-205	214.33

Table 5: Exchangeable Ca & Mg (meq 100g^{-1})

Block	Ex Ca (meq 100g^{-1})		Ex Mg (meq 100g^{-1})	
	Range	Mean	Range	Mean
V_1	4.2-4.7	4.45	0.85-1.00	0.92
V_2	3.8-4.1	3.95	0.80-1.00	0.90
V_3	2.8-3.5	3.15	0.75-0.90	0.82
V_4	3.5-3.7	3.60	0.85-1.08	0.96
V_5	4.0-4.8	4.40	0.98-1.08	1.03
V_6	3.5-3.9	3.70	0.75-0.95	0.84
V_7	3.8-4.6	4.20	0.87-1.05	0.95
V_8	4.4-4.8	4.60	0.78-1.04	0.90
V_9	4.0-4.7	4.35	0.97-1.10	1.02

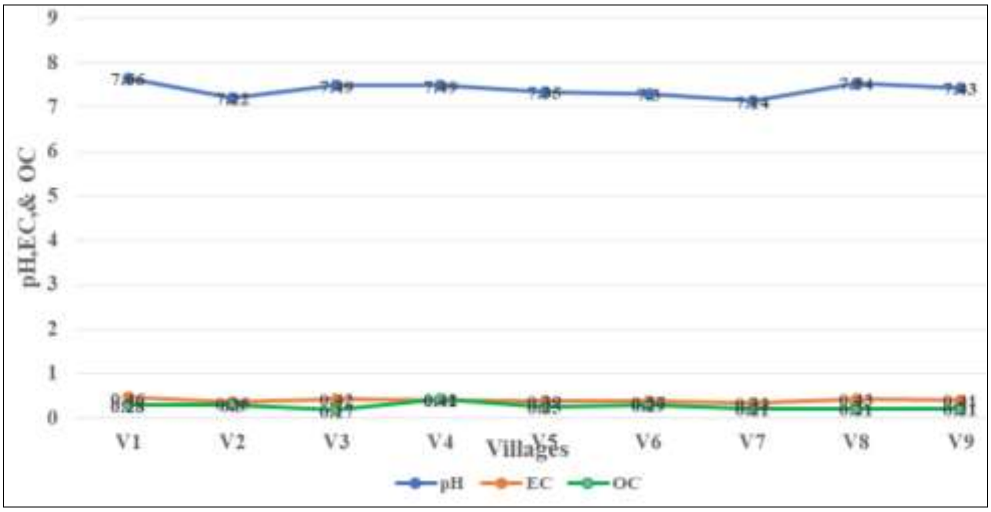

Fig 3: pH, EC (dS m^{-1}) & OC (%)

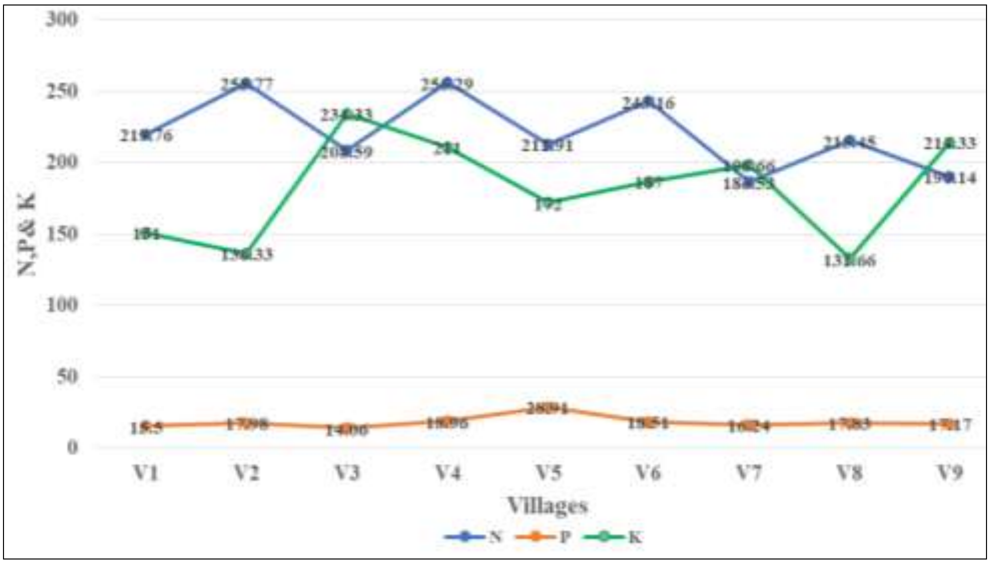

Fig 4: Available Nitrogen, Phosphorus & Potassium (kg h^{-1})

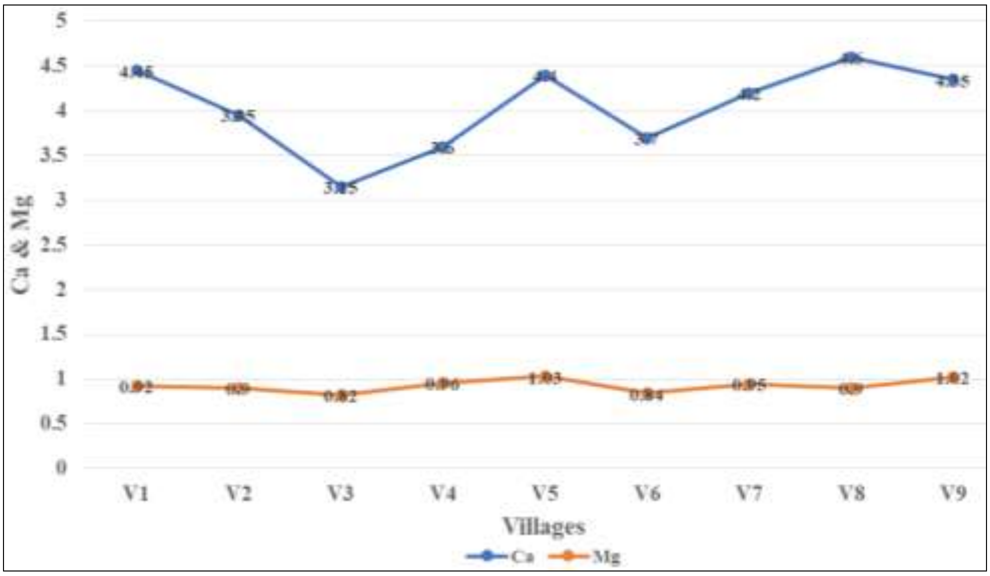

Fig 5: Exchangeable Ca & Mg (meq $100g^{-1}$)

Conclusion

It can be concluded that the soils of Deegh block of Bhadohi, Uttar Pradesh are in good physical condition which favours the cultivation of most of the crops, especially Maize and Wheat. Soil texture showed high clay percentage, neutral in pH, very low to low organic carbon content, low to medium in NPK, high in Ca and low in Mg. The major reason for lack of macronutrients is low organic matter contents and inappropriate management practices. It suggests that still improvement can be done by improving cropping pattern, decomposition of organic waste, mulching, tillage practices and proper irrigation by management practices with knowledge and experience gained through studies and suggest the farmers to achieve quality produce and high yield through soil health card report as well as practices of soil conservation and 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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