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Ankita Das
Research Scholar, Department of Soil Science and Agricultural Chemistry, Naini Agricultural Institute, Sam Higgin Bottom University of Agriculture Technology and Science, Prayagraj, Uttar Pradesh, India

Dr. Amreen Hassan
Assistant Professor, Department of Soil Science and Agricultural Chemistry, Naini Agricultural Institute, Sam Higgin Bottom University of Agriculture Technology and Science, Prayagraj, Uttar Pradesh, India

Dr. Tarence Thomas
Professor and Head, Department of Soil Science and Agricultural Chemistry, Naini Agricultural Institute, Sam Higgin Bottom University of Agriculture Technology and Science, Prayagraj, Uttar Pradesh, India

Akshita Barthwal
Ph.D. Research Scholar, Department of Soil Science and Agricultural Chemistry, Naini Agricultural Institute, Sam Higgin Bottom University of Agriculture Technology and Science, Prayagraj, Uttar Pradesh, India

Corresponding Author
Ankita Das
Research Scholar, Department of Soil Science and Agricultural Chemistry, Naini Agricultural Institute, Sam Higgin Bottom University of Agriculture Technology and Science, Prayagraj, Uttar Pradesh, India

Nutrient index of soil from Sepahijala district Tripura

Ankita Das, Dr. Amreen Hassan, Dr. Tarence Thomas and Akshita Barthwal

Abstract
An experiment was conducted in Department of Soil Science and Agricultural Chemistry, Prayagraj duration 2021-22. Soil samples were collected from Uttar Charilam, Chessmail, Rangmala, Taksapara, Khas Chowmuhani, Rabi Gopalpara, Karaimura, Ratan Nagar, Ganiamara villages of Sepahijala Tripura from three depths, *viz*. 0-15 cm, 15-30 cm and 30-45cm. nine sampling points were selected for the analysis. The results revealed that the soil colour varied from yellowish brown to pale brown colour in the dry condition while dark yellowish brown to Very dark grayish brown colour predominated in the wet condition. The texture in Charilam and Bishalghar was mostly sandy clay loam while in Nalchar, the texture was Sandy clay loam. The bulk density, particle density, water holding capacity, specific gravity and pore space are good ranged. The pH range is acidic, electrical conductivity is good range. High organic carbon has obtaine. Available nitrogen range is medium, available phosphorus and available potassium content range is low.

Keywords: Physical properties and chemical properties of soil

Introduction
The soil of Tripura is marked by different features that topographical changes in the state. The soil in Tripura can be classified into five distinct categories. 43.07% of total land area of the state is occupied by red loamy soil and the sandy soil. The soil type is the second most dominant type in the region covering 33.06% of the land area**.** The word soil represents one amongst the foremost active and complex natural systems on the earth's surface. The physical and chemical characteristics of soil play a giant role within the plant's ability to extract water and nutrients. Prime quality soils not solely turn out higher food and fiber, but also help to ascertain natural ecosystems and enhance air and water quality. The physical properties of the soil depend on the quantity, shape, structure, size, pore areas, organic matter and mineral composition of soil. The chemical properties of soil are the interactions of assorted chemical constituents among soil particles and also the soil answer. These physical and chemical properties ar soil texture, bulk density, particle density, pore space, soil structure, soil color, pH, electrical conduction, organic carbon, nitrogen, potassium, phosphorus. All soils have totally different properties and dealing with them needs understanding of those properties.

Materials and Methods
A. Soil Sampling: Soil samples were collected from three different blocks italics Charilam, Nalchar and Bishalgarh block of Sepahijala District of Tripura. And from each block soil samples were taken from three different villages. Taking soil samples from the areas such as water logged area, areas near main bund, trees, manure heaps and irrigation channels were avoided. Soil samples were collected from three different depths i.e., 0-15cm, 15-30cm and 30-45 cm. The first surface area of the sampling spot was cleared out. Weeds, leaves, stones were removed. A 'V' shaped pit of 15 cm depth was dug out with the help of garden hoe/spade, depth was measured by a meter scale and 1 to 2 cm slice of soils were collected using garden hoe /spade. The soil sample was collected by clean cloth and polythene bag. Required information such as date, soil sampling no, sample depth, GPS coordinates of the sampling site, farmer's name, field name and crop history was labelled in a paper and was attached to the bag. A total no of 27 soil samples were collected from 9 different villages.

B. Statistical Analysis: The data recorded during the course of an investigation was subjected to statistical analysis by the method of analysis of variance (ANOVA) technique (Fisher, 1960) [8]. The type of ANOVA adopted for the experiment was a two-factor analysis without

replication. The implemented design of an experiment in the analysis done was Completely Randomized Design (CRD).

C. Analysis of Morphological parameters: Soil texture analysis of particles but 2mm was performed by the Bouyoucos measuring system technique. The color of the soil samples each in dry and wet condition were matched against the quality to the Hue, worth and saturation Munsell Soil color Chart.

D. Analysis of physical parameters: The Soil majority density, particle density, pore space, Water holding capability of soil was measured with the assistance of a hundred cubic centimetre 100ml measurement cylinder technique. The specific gravity of soil was firm by the denseness bottle technique.

E. Analysis of chemical parameters: The pH of the soil samples was determined in 1:2 i.e., soil: water suspension. Soil pH was measured by using digital pH meter instrument. EC was measured by using Digital EC Meter. The electrical conductivity of soil samples was determined in 1:2 soil water suspension using the conductivity meter. Organic Carbon content of the soil was observed by method of Wet oxidation. In this method organic carbon is oxidized with chromic acid (potassium dichromate + H_2SO_4). The unconsumed potassium dichromate is back titrated against ferrous ammonium sulphate (redox titration) in the presence of diphenylamine as an indicator. The content was titrated until green colour started appearing by. Available nitrogen was observed by using alkaline method of potassium permanganate ($KMnO_4$). The NH_3 formed was collected in 2% boric acid solution and was titrated against 0.02N HCl till the green colour of the distillate was changed to distinct pink colour. The available phosphorus in the soil was estimated colorimetric ally by a Photoelectric Colorimeter, Phosphorus is extracted from soil with 0.5 M $NaHCO_3$ adjusted to pH 8.5. Blue colour is developed by ascorbic acid method. The exchangeable potassium was extracted from 1.0N Ammonium acetate (pH 7.0). Potassium was observed by Flame Photometer.

Results and Discussion

I) Physical Properties of Soil

A) Soil texture: The Soil texture (Sand, Silt, and Clay %) of different soil samples that were taken from respective depths (0-15, 15-30 cm, and 30-45cm) from different villages of Sepahijala District, Tripura. The sand content varied from 30.36-56.77%, Silt varied from 14.6-40.47%, and Clay varied from 27.01-30.20%. Similar results were also reported by Majumder *et al*., (2014).

B) Soil color: The soil color of samples varies Brownish yellow to Yellowish brown in dry conditions and Dark yellowish brown to Very dark grayish brown in wet conditions. The Yellowish brown colour of the soil is due to indicates good drainage. Iron constitute within the soil is oxidised additional readily due to the higher oxygen substance. The colour can be darker due to organic matter Gangopadhyay *et al*., (2015) [9].

C) Bulk density (Mg m-3): As shown statistical accumulation on Bulk Density (Mg m-3) of soil in Sepahijala District. No significant difference was found due to depth and significant difference was found due to site. The Bulk Density ranged from 1.13 to 1.48 Mg m-3. The maximum value found in V9 (30-45 cm depth) 1.48 Mg m-3 and the minimum value found in V1 (0-15 cm depth) 1.13 Mg m-3. The Bulk Density increases with the rise in soil depth. The reason is soil compactness, which will be more at high depth and soil organic carbon will be decreased with increasing the depth because of lower organic carbon and higher compactness of soils bulk density will be increased with increasing the depth similar results were also reported by Wankhade *et al*., (2011).

D) Particle density (Mg cm-3)

As presented in statistical accumulation on Particle Density (Mg m-3) of soil in Sepahijala District. No significant difference was found due to depth and due to site. The particle density ranged from 2.12 to 2.54 Mg m-3. The maximum value found in v9(30-45 cm depth) 2.54 Mg m-3 which indicates that the soil has comparatively lower organic matter and the minimum value found in V1(0-15 cm depth) 2.12 Mg m-3which indicates the presence of high organic matter. Particle Density varies according to the mineral content of the soil particles similar results were also reported by Barthwal *et al*., (2019) [1].

E) Pore space (%)

As depicted in statistical accumulation on Pore Space (%) of soil in Sepahijala District. No Significant difference was found due to depth and due to site. The Pore Space (%) ranged from 31.58 to 64.75 (%). The maximum value found in V9 (0-15 cm depth) 64.75 (%) and the minimum value found in V2 (30-45 cm depth) (%) 31.58. Pore Space was found to decrease with increase in depth attributed to increase in compaction in the sub surface similar results were also reported by Pandey *et al*., (2018).

Table 1: Bulk density, Particle density, and % pore space of different villages of Sepahijala District

Blocks/ Sites	0-15 cm	15-30 cm	30-45 cm	Mean	Blocks / Sites	0-15 cm	15-30 cm	30-45 cm	Mean	Blocks / Sites	0-15 cm	15-30 cm	30-45 cm	Mean
Charilam(B1)					**Charilam(B1)**						**Charilam(B1)**			
V1	1.13	1.16	1.19	1.16	V1	2.12	2.18	2.24	2.18	V1	60.14	55.17	45.19	53.5
V2	1.15	1.26	1.30	1.2366	V2	2.16	2.26	2.32	2.2466	V2	52.61	47.42	31.58	43.87
V3	1.17	1.25	1.39	1.27	V3	2.20	2.28	2.36	2.28	V3	58.83	55.54	43.75	52.7066
Nalchar(B2)					**Nalchar(B2)**					**Nalchar(B2)**				
V4	1.19	1.30	1.38	1.29	V4	2.22	2.31	2.38	2.3033	V4	60.52	52.91	47.05	53.49333
V5	1.23	1.29	1.42	1.3133	V5	2.26	2.30	2.36	2.3066	V5	52.63	47.05	33.41	44.36333
V6	1.27	1.32	1.45	1.3466	V6	2.28	2.35	2.42	2.35	V6	55.51	48.05	40.01	47.85667
Bishalghar(B3)					**Bishalghar(B3)**					**Bishalghar(B3)**				
V7	1.29	1.35	1.38	1.34	V7	2.32	2.37	2.47	2.3866	V7	60.13	56.21	55.52	57.28667
V8	1.21	1.33	1.46	1.3333	V8	2.35	2.43	2.50	2.4266	V8	64.71	50.03	47.05	53.93
V9	1.28	1.34	1.48	1.3666	V9	2.38	2.46	2.54	2.46	V9	64.75	61.18	56.26	60.73

Mean	1.2133	1.288	1.383		Mean	2.25444	2.3266	2.39888		Mean	58.87	52.617	44.424	
		F-test	SEm(±)	CD at 5%			F-test	SEm (±)	CD at 5%			F-test	SEm(±)	CD at 5%
	Due to depth	S	0.0789	0.01209		Due to depth	S	0.07222	8.9869		Due to depth	NS	155.9122	0.0039
	Due to site	NS	0.0701	0.1324		Due to site	S	0.0887	7.0979		Due to site	NS	51.9707	0.0116

F) Water holding capacity (%)

As shown in statistical accumulation on Water Holding Capacity (%) of soil in Sepahijala District. Significant difference was found due to depth and no significant difference was found due to site. The water holding capacity (%) ranged from 40.01 to 59.53%. The maximum value found in V6 (0-15 cm depth) 59.53% and the minimum value found in V9 (30-45 cm depth) 40.01%. Water Holding Capacity value decrease with the increase depth because of soil compaction and reduction in pore space. Soils vary in their water holding capacity according to their structure, texture and bulk density relationship to total pore size distribution similar results were also reported by Chaudhuri, P.S. and Nath, S. (2011) [5].

G) Specific gravity

As presented in statistical accumulation on Specific Gravity of soil in Sepahijala District. No significant difference was found due to depth and due to site. The specific gravity ranged from 1.27 to 2.13. The maximum value found inV8 (30-45 cm depth) 2.13 and the minimum value found in V2 (0-15cm depth) 1.27 and this due to presence of organic matter and porous particles in soil similar results were also reported by Tripura, D. and Sarkar, P.P. (2011) [14].

Table 2: Evaluation of Water Holding Capacity and Specific Gravity of different villages of Sepahijala District

Blocks/ Sites	0-15 cm	15-30 cm	30-45 cm	Mean	Blocks/Sites	0-15 cm	15-30 cm	30-45 cm	Mean
Charilam (B1)					**Charilam (B1)**				
V1	59.31	45.81	40.03	48.38333	V1	1.43	1.52	1.61	1.52
V2	56.28	46.32	42.13	48.24333	V2	1.27	1.38	1.45	1.366667
V3	52.41	47.53	43.17	47.70333	V3	1.62	1.81	1.99	1.806667
Nalchar (B2)					**Nalchar (B2)**				
V4	58.29	48.41	40.08	48.92667	V4	1.35	1.52	1.71	1.526667
V5	58.42	49.38	41.14	49.64667	V5	1.32	1.55	1.74	1.536667
V6	59.53	45.61	42.15	49.09667	V6	1.36	1.57	1.85	1.593333
Bishalghar (B3)					**Bishalghar (B3)**				
V7	51.35	44.82	40.82	45.66333	V7	1.68	1.86	2.05	1.863333
V8	57.91	47.39	41.2	48.83333	V8	1.74	1.95	2.13	1.94
V9	50.83	46.81	40.01	45.88333	V9	1.65	1.79	2.08	1.84
MEAN	56.03667	46.89778	41.19222		MEAN	1.491111	1.661111	1.845556	
		F-test	SEm(±)	CD at 5%			F-test	SEm(±)	CD at 5%
	Due to depth	S	7.4881	0.0075		Due to depth	NS	0.1772	0.0080
	due to site	NS	1.4002	0.6372		Due to site	NS	0.1988	0.0041

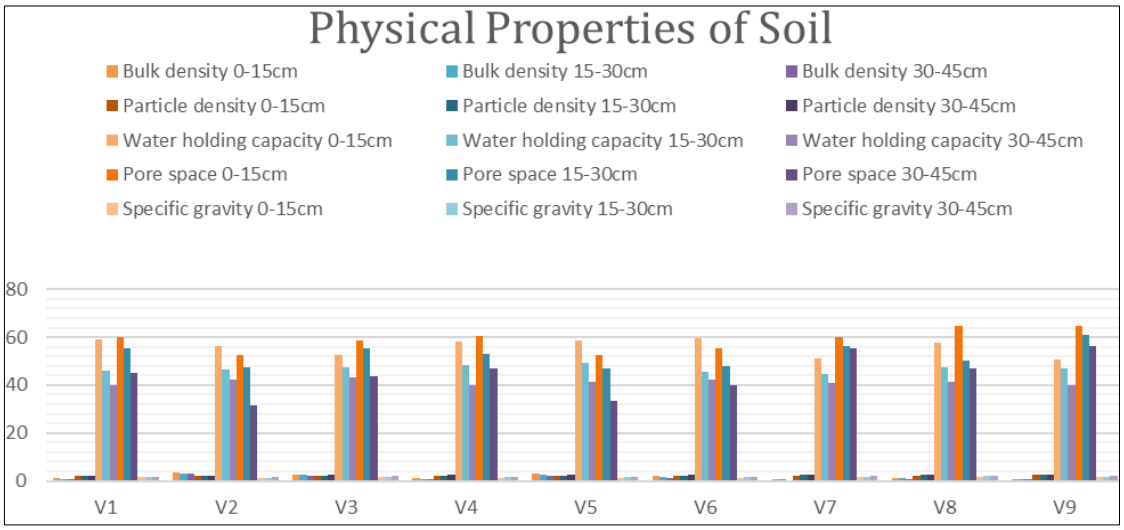

Fig 1: Graphical representation of Bulk density, Particle density, % pore space, Water Holding Capacity and Specific Gravity of different villages of Sepahijala District, Tripura.

II) Chemical Properties of Soil

A) Soil Ph

As depicted in statistical accumulation on pH of soil in Sepahijala District. No Significant difference was found due to depth and due to site. The pH ranged from 6.53 to 7.66. The maximum value found in V9 (30-45 cm depth) 7.66 and the minimum value found in V1 (0-15 cm depth) 6.53, thereby indicating the soils are moderately neutral to alkaline. pH value increases with the increasing depth because the upper horizons receive maximum leaching by rainfall similar results were also reported by Choudhary *et al*., (2016) and Reza *et al*., (2010) [4, 13].

B) Soil EC

As shown in statistical accumulation on EC (dS m-1) of soil in Sepahijala District. Significant difference was found due to depth and no significant difference was found due to site. The electrical conductivity ranged from 0.17 to 0.39dS m-1. The maximum value found in V4 (30-45 cm depth)0.39dS m-1 and the minimum value found in V1(0-15cm depth)0.17dS m-1 similar results were also reported by Datta *et al*., (2008).

Table 3: Evaluation of pH and Electrical conductivity of different villages of Sepahijala District

Blocks/ Sites	0-15 cm	15-30 cm	30-45 cm	MEAN	Blocks/Sites	0-15 cm	15-30 cm	30-45 cm	MEAN
Charilam (B1)					**Charilam (B1)**				
V1	6.53	6.79	7.56	6.96	V1	0.17	0.23	0.29	0.23
V2	6.64	6.77	7.16	6.856667	V2	0.21	0.28	0.35	0.28
V3	6.76	6.96	7.23	6.983333	V3	0.18	0.25	0.38	0.27
Nalchar (B2)					**Nalchar (B2)**				
V4	6.68	6.89	7.26	6.943333	V4	0.23	0.31	0.39	0.31
V5	6.74	7.03	7.31	7.026667	V5	0.26	0.33	0.37	0.32
V6	7.04	7.25	7.55	7.28	V6	0.20	0.27	0.34	0.27
Bishalghar (B3)					**Bishalghar (B3)**				
V7	6.88	7.14	7.43	7.15	V7	0.27	0.35	0.38	0.333333
V8	6.94	7.23	7.61	7.26	V8	0.22	0.31	0.39	0.306667
V9	7.06	7.39	7.66	7.37	V9	0.25	0.32	0.37	0.313333
Mean	6.807778	7.05	7.418889		Mean	0.221111	0.294444	0.362222	
		F-test	SEm(±)	CD at 5%			F-test	SEm(±)	CD at 5%
	Due to depth	NS	0.3077	5.1824		Due to depth	S	0.0705	0.0040
	due to site	NS	0.1786	0.0011		Due to site	NS	0.0324	0.1900

C) Available Nitrogen (Kg ha-^{1})

As depicted in statistical accumulation on Available Nitrogen (kg ha-^{1}) of soil in Sepahijala District. No Significant difference was found due to depth and due to site. The available Nitrogen (kg ha-^{1}) ranged from 331.74 to 443.19 kg ha-^{1}. The maximum value found in V1 (0-15 cm depth) 443.19 kg ha-^{1} and the minimum value found in V6 (30-45 cm depth) 331.74 kg ha-^{1}. The available Nitrogen decrease with the increase depth due to the fact it is positively correlated with organic matter content which decreases with depth and might be due to higher pH to the depth similar results were also reported by Reza *et al*., (2010), Rahman and Nath (2018) [13, 12].

D) Available Phosphorus (Kg ha-^{1})

As shown in statistical accumulation on Available Phosphorous (kg ha-^{1}) of soil in Sepahijala District. No Significant difference was found due to depth and due to site. The available Phosphorous (kg ha-^{1}) ranged from 7.54 to 10.12 kg ha-^{1}. The maximum value found in V5 (0-15 cm depth) 10.12 kg ha-^{1} and the minimum value found in V2 (30-45 cm depth) 7.54 kg ha-^{1}. The available Phosphorous decrease with the increase depth. Higher level of available Phosphorous in surface soil could be attribute of favourable soil pH and organic matter content similar results were reported by Yadav *et al*., (2017) [15].

E) Available Potassium (Kg ha-^{1})

As presented in statistical accumulation on Available Potassium (kg ha-^{1}) of soil in Sepahijala District. No Significant difference was found due to depth and due to site. The available Potassium (kg ha-^{1}) ranged from 69.87 to 91.23 kg ha-^{1}. The maximum value found in V3 (0-15 cm depth) 91.23 kg ha-^{1} and the minimum value found in V4 (30-45 cm depth) 69.87 kg ha-^{1}. The available Potassium decrease with the increase depth. The high content of available Potassium on surface soil may be attributed to the release of labile K from organic residues and application of potassium fertilizers similar results were also reported by Datta *et al*., (2016) and Reza *et al*., (2010) [4, 13].

Table 4: Evaluation of Available Nitrogen, Available Phosphorus and Available Potassium of different villages of Sepahijala District

Blocks/ Sites	0-15 cm	15-30 cm	30-45 cm	Mean	Blocks/ Sites	0-15 cm	15-30 cm	30-45 cm	Mean	Blocks/ Sites	0-15 cm	15-30 cm	30-45 cm	Mean
Charilam(B1)					**Charilam(B1)**					**Charilam(B1)**				
V1	443.19	414.28	387.34	414.937	V1	9.52	9.06	8.45	9.01	V1	88.67	82.58	77.34	82.86333
V2	438.35	409.67	381.54	409.853	V2	9.46	8.71	7.54	8.57	V2	83.66	78.91	72.77	78.44667
V3	441.76	**417.12**	**383.82**	**414.233**	**V3**	**9.92**	**9.41**	**8.76**	**9.36333**	**V3**	**91.23**	**87.77**	**78.12**	85.70667
Nalchar(B2)					**Nalchar(B2)**					**Nalchar(B2)**				
V4	431.72	401.53	378.62	403.956	V4	10.08	9.58	8.79	9.483333	V4	79.33	73.66	69.87	74.28667
V5	398.97	365.26	338.89	367.706	V5	10.12	9.52	8.41	9.35	V5	90.79	83.55	78.69	84.34333
V6	389.77	356.28	331.74	359.263	V6	9.76	9.12	8.86	9.246667	V6	83.67	77.34	73.27	78.09333
Bishalghar(B3)					**Bishalghar(B3)**					**Bishalghar(B3)**				
V7	411.78	376.22	341.88	376.626	V7	9.91	9.42	8.72	9.35	V7	85.87	79.62	74.83	80.10667
V8	406.26	378.55	344.29	376.366	V8	9.85	9.36	8.88	9.363333	V8	82.55	77.68	72.92	77.71667
V9	391.76	363.96	336.66	364.126	V9	9.38	8.66	7.62	8.553333	V9	80.12	74.85	70.86	75.27667
Mean	417.0622	386.98	358.308		Mean	9.777778	9.20444	8.447778		Mean	85.09889	79.55111	74.29667	
		F-test	SEm(±)	CD at 5%			F-test	SEm(±)	CD at 5%			F-test	SEm(±)	CD at 5%
	Due to depth	NS	29.3794	3.8317		Due to depth	NS	0.6671	0.0237		Due to depth	NS	5.4017	0.0113
	Due to site	NS	22.9551	1.7545		Due to site	NS	0.3540	0.0079		Due to site	NS	3.9488	0.0845

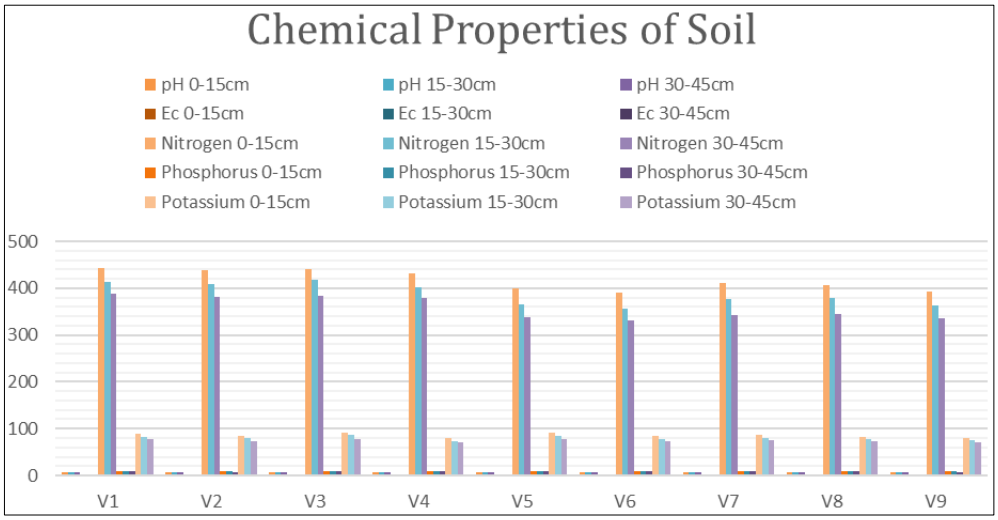

Fig 2: Graphical representation of pH, Electrical conductivity, Available Nitrogen, Available Phosphorus and Available Potassium of different villages of Sepahijala District Tripura.

Conclusion

It is terminated that soil parameters were studied throughout the course of investigation responded sensible physical properties and pH scale is acidic.EC is good, Nitrogen (kg ha-[1]) is medium, Organic Carbon (%) is high, Potassium and Phosphorus (kg ha-[1]) in low range. Cultivation is principally confined to Kharif season however on convenience of irrigation. Rabi crops are grownup. Rice, maize area unit the foremost kharif crops of the rough Tripura. Completely different crops grownup throughout Rabi season area unit rice, wheat, potato. The most crops grown up in Sepahijala Tripura region area unit paddy, tea. Paddy is grownup in fifty fifth of gross cropped space in three season's *viz*. Aush (Prekharif), Aman (Kharif) and Boro (summer). The results so show that in totality, organic farming not solely improves the wholeness of the soil however additionally enrich the soil with essential plant nutrients at low prices of production, well benefiting the farmer. Sepahijala Tripura soils additionally would like improvement in voidance for successful production of crops like maize, soybean, arhar.

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