Original Research Article

Assessment of Physico-Chemical Properties of Soil from DifferentBlocks of Eluru District, Andhra Pradesh, India

Abstract

The experiment was conducted in 2023 to assess the physical and chemical properties of different blocks of Elurudistrict, Andhra Pradesh.Three distinct villages were chosen from each block for the study. The physicalproperties ofEluru district soils, soil colour, texture, bulk density(mg m^{-3}), particle density (mg m^{-3}), percent pore space and percent water retainingcapacity and chemical properties pH, EC (dSm^{-1}) at 25˚C, percent organic carbon, available nitrogen, phosphorus and potassium (kg ha^{-1}), calcium C mol(p^{+}) $kg^{-1}$and magnesium Cmol(p^{+}) kg at 0-15, 15-30 and 30-45cm depth.Findings showed that in terms of depth, there was a minor rise in both bulk and particle density. The water retaining capacity of the soil and the overall physical condition of the soil was found good and supportive for plant growth. The soils of selected villages of different blocks in Eluru district were found to acidic to basic in nature due to soil minerals producing sodium carbonate (Na_2CO_3) and sodium bicarbonate ($NaHCO_3$) upon weathering. The organic carbon, nitrogen and phosphorus were observed as medium to high. The potassium content was low in all locations.There was enough calcium present, however there were several regions where magnesium was lacking. The deficiency of the nutrients can be mitigated by the use of organic and inorganic fertilizers.

Key words: Eluru, Physico-chemical properties of soil, Andhra Pradesh, weathering

1. INTRODUCTION

Soil is an important element essential for the survival of living organisms [1]. Soil Testing is well recognized as an important technique to assess inherent nutrient supplying capacity of soil to the growing plants [2]. Andhra Pradesh is a state in the south-eastern coastal region of India. It is the seventh largest state by area covering an area of 162,975 km^2(62,925 sq. mi)[3].The city of Eluru lies at 16.7107°N 81.0952°E. The average rainfall is 119.02 mm yearly. The Soils in the district are made up of Alluvial, Black, Red and sandy soils.Paddy, banana, sugarcane, and coconut are the main agricultural products cultivated,and the Cashew nut, mango and tobacco are other important production from the district [4,25,26,27,28].

The study titled “Assessment of Physico-chemical Properties of Soil from Different Taluk of Eluru District in the State of Andhra Pradesh, India” aims to evaluate the physico-chemical status of soils at both district and village levels. It seeks to provide a detailed analysis of soil properties, offering significant insights and guidelines to help farmers improve soil management practices and enhance agricultural productivity.

2. MATERIALS AND METHODS

Soil samples were collected from three different block i.e., Kaikaluru, Eluru and Denduluru of Eluru district. From each block soil samples were taken at a profile depth of 0-15, 15-30, 30-45 cm. A total 27 soil samples were collected from nine different villages. In each soil sampling bag 500 gm of soil was collected. Each soil samples were spread on a clean white paper sheet in the shade and air dried at room temperature. The large lumps/clods were crushed/broken to its ultimate soil particle using a wooden mallet. The powdered soil was sieved through 2 mm sieve. The soil material was collected in a clean cloth or polythene bag and was labelled properly for laboratory analysis.The physical properties of soils, soil colour, texture, bulk density (mg m^{-3}), particle density (mg m^{-3}), percent pore space and percent water retainingcapacity were analysed with the following standard procedure [5],[6], [7] and chemical properties pH, EC (dSm^{-1}) at 25˚C, percent organic carbon, available nitrogen, phosphorus and potassium (kg ha^{-1}), calciumC mol(p^{+}) $kg^{-1}$and magnesiumC mol(p^{+}) kg^{-1} were analyzed by following [8],[9], [10], [11], [12],[13]and [14]at 0-15, 15-30 and 30-45cm depth. The data recorded during the course of the investigation was completely randomized design, as per the method "Analysis of Variance technique" as given by[15].

3. RESULTS AND DISCUSSION

The results (table 1) indicates thatthe soil colour of dry condition varies from greyish brown to yellowish red in 0-15 cm depth, from light brownish to red in 15-30 cm depth and from grey to red in 30-45 cm depth. The soil colour of wet condition varies from dark brown to dark red in 0-15 cm depth, from very dark to red in 15-30 cm depth and from very dark grey to red in 30-45 cm depth.In comparison to dry soil, wet soils are typically darker.The results (table 2) indicates that the soil texture Eluru district is dominantly found as sandy loam, clay and sandy clay. The sand, silt and clay percentage varied from 25.14% to 67.12%, 16.50% to 23.15% and 11.49% to 54.21%. Comparable outcomes were discovered by [16].The results (table 3)indicates thatthe bulk density of soil varies from 1.06 to 1.33 mg m^{-3}in selected blocks of Elurudistrict,Andhra Pradesh. It is clear that the bulk density increases with the increase in soil depth due to soil compactness. Comparable outcomes were discovered by [17], andthe particle density of soil varied from 2.15to 2.59mg m^{-3}. According to depth, the particle density likewise rises.Particle density varies according to mineral content of soil particles. Comparable outcomes were discovered by [18].The findings(table 4) indicatethat thepore space (%) of soil ranged from 41.56 to 50.27 %. The pore space found to decrease with increase in depth at attributed to increase in compaction in the sub surface.

Surface soils are having high amount of macro and micro pores compared to sub surface soil due to presence of high organic matter. Comparable outcomes were discovered by [18], andthe water retaining capacity of soil (%) ranged from 40.33 to 49.85 %. The waterretaining capacity value decrease with increase in 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. Comparable outcomes were discovered by [19].The findings(table 5)indicate that the pH value of soil ranged from 5.87 to 8.05.The soils of selected villages of different blocks in Eluru district were found to acidic to basic in nature. The causes of soil alkalinity can be natural or man-made: The

natural cause is the presence of soil minerals producing sodium carbonate (Na_2CO_3) and sodium bicarbonate ($NaHCO_3$) upon weathering. Comparable outcomes were discovered by [20].The findings (table 6)indicate thatthe electrical conductivity of soil ranged from 0.14 to 0.87 dS m^{-1}.

The soil samples are clearly acceptable for most crops and satisfy the permitted EC level. Comparable outcomes were discovered by [16], and the value of total organic carbon (%) of soil varied from 0.30 to 1.60 %.The block that was chosen has a medium level of organic matter because to microbial activity and the deposition of plant residue. Comparable outcomes were discovered by [21].The findings(table 7) indicatethat the available nitrogen content of soil ranged from 120.0 to 350.0 kg ha^{-1}.The district ofEluruvillages all have medium nitrogen levels.Available nitrogen decreases with the increasing 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 depth. Comparable outcomes were discovered by [22].The findings (table 7)indicate that the available phosphorus content of soil ranged from 22.0 to 94.0 kg ha^{-1}.

Available phosphorus decreases with the increasing depth. Higher level of available phosphorus in surface soil could be attribute of favorable soil pH and organic matter content. Comparable outcomes were discovered by [23].The findings (table 7)indicate that availablepotassium content of soil ranged from 14.0 to77.0 kg ha^{-1}. Availablepotassium decreases with the increasing depth. The high content of available potassium on surface soil may be attributed to the release of available K form organic residues and application ofpotassium fertilizers. Comparable outcomes were discovered by [23]. The findings (table 8) indicate that exchangeablecalcium and magnesium content of soil ranged from 1.90 to 9.60 (cmol (p^+) kg^{-1}), 0.20 to 3.90 (cmol (p^+) kg^{-1}) respectively in selected blocks. The calcium and magnesium decrease with the increasing in depth due to the attributes of high pH towards the depth. Comparable outcomes were discovered by [24].

Table 1.Soil colour in dry and wet condition of different block of Eluru district, Andhra Pradesh

Block	Village	Dry condition			Wet condition		
		0-15 cm depth	15-30 cm depth	30-45 cm depth	0-15 cm depth	15-30 cm depth	30-45 cm depth
Kaikaluru	Varahapatnam	10YR 5/2 greyish brown	10YR 6/2 light brownish grey	10YR 5/1 grey	7.5YR 4/2 dark brown	10YR 3/0 very dark grey	10YR 3/1 very dark grey
	Tamarakollu	10YR 5/1 grey	10YR 7/1 light grey	5Y 5/2 olive grey	5YR 4/1 dark grey	5YR 4/1 dark grey	5Y 3/2 dark olive grey
	Achavaram	10YR 6/2 light brownish grey	10YR 7/1 light grey	10YR 6/1 grey	2.5YR 4/4 olive brown	10YR 3/3 dark brown	10YR 4/2 dark greyish brown
Eluru	Sreeparru	2.5Y 4/2 dark greyish brown	2.5YR 5/4 light olive brown	2.5Y 5/6 light olive brown	2.5YR 4/2 dark greyish brown	2.5Y 4/2 dark greyish brown	2.5Y 4/2 dark greyish brown
	Madepalli	10YR 7/2 light grey	5Y 5/6 olive	5Y 6/6 olive yellow	5Y 4/3 olive	5Y 4/4 olive	5Y 5/3 olive
	Malkapuram	10YR 6/3 pale brown	2.5Y 4/4 olive brown	5Y 5/6 olive	5Y 4/4 olive	2.5Y 4/2 dark greyish brown	5Y 4/2 olive grey
Denduluru	Denduluru	7.5YR 4/4 dark brown	2.5Y 6/4 light yellowish brown	10YR 6/8 brownish yellow	2.5Y 5/6 light olive brown	2.5Y 5/6 light olive brown	10YR 5/8 yellowish brown
	Challachintalapudi	5YR 3/3 dark reddish brown	2.5YR 3/6 dark red	10R 4/6 red	5YR 4/3 reddish brown	2.5YR 4/4 reddish brown	10R 3/6 dark red
	Ramaraogudem	5YR 4/6 yellowish red	2.5YR 4/6 red	2.5YR 5/8 red	2.5YR 3/6 dark red	2.5YR 4/8 red	2.5YR 4/8 red

Table 2.Soil texture of different block of Eluru district, Andhra Pradesh at 0-15, 15-30 and 30-45cm

S. No.	Block	Village	Sand%	Silt%	Clay%	TexturalClass
1	Kaikaluru	Varahapatnam B_1V_1	67.12	20.08	12.80	Sandy Loam
		Tamarakollu B_1V_2	64.48	21.36	14.16	Sandy Loam
		Achavaram B_1V_3	65.36	23.15	11.49	Sandy Loam
2	Eluru	Sreeparru B_2V_1	28.05	18.27	53.68	Clay
		Madepalli B_2V_2	25.14	20.65	54.21	Clay
		Malkapuram B_2V_3	30.36	17.53	52.11	Clay
3	Denduluru	Denduluru B_3V_1	46.15	17.04	36.81	Sandy Clay
		Challachintalapudi B_3V_2	48.38	16.50	35.12	Sandy Clay
		Ramaraogudem B_3V_3	45.10	19.34	35.56	Sandy Clay

Block	Village	BulkDensity (mgm^{-3})		ParticleDensity(mgm^{-3})	
		Range	Mean	Range	Mean
Kaikaluru	Varahapatnam B_1V_1	1.27 – 1.31	1.29	2.53 – 2.59	2.56
	Tamarakollu B_1V_2	1.25 – 1.29	1.27	2.46 – 2.50	2.48
	Achavaram B_1V_3	1.28 – 1.30	1.29	2.43 – 2.47	2.44
Eluru	Sreeparru B_2V_1	1.17 – 1.22	1.19	2.50 – 2.56	2.52
	Madepalli B_2V_2	1.25 – 1.29	1.26	2.50 – 2.53	2.51
	Malkapuram B_2V_3	1.30 - 1.33	1.31	2.35 – 2.39	2.37
Denduluru	Denduluru B_3V_1	1.17 – 1.22	1.19	2.22 – 2.24	2.23
	Challachintalapudi B_3V_2	1.14 – 1.19	1.16	2.19 – 2.27	2.23
	Ramaraogudem B_3V_3	1.06 – 1.12	1.09	2.15 – 2.23	2.19

Table3. Bulk density (mg m^{-3}) and Particle Density (mg m^{-3}) of soil at different block of Eluru district, Andhra Pradesh

Table 4. Pore Space (%) and Water Retaining Capacity (%) of soil at different block of Eluru district, Andhra Pradesh

Block	Village	Pore space (%)		Water Retaining Capacity (%)	
		Range	Mean	Range	Mean
Kaikaluru	Varahapatnam B_1V_1	44.61 – 49.68	47.05	43.82 – 48.66	45.59
	Tamarakollu B_1V_2	45.29 – 49.37	47.39	42.81 – 47.54	45.16
	Achavaram B_1V_3	43.92 – 47.43	45.37	41.14 – 45.67	43.38
Eluru	Sreeparru B_2V_1	45.11 – 50.27	47.73	43.97 – 49.85	46.27
	Madepalli B_2V_2	44.32 – 48.78	46.93	41.71 – 46.69	44.68
	Malkapuram B_2V_3	41.56 – 46.66	44.36	40.36 – 45.62	42.85
Denduluru	Denduluru B_3V_1	42.67 – 47.05	44.74	41.50 – 46.70	43.78
	Challachintalapudi B_3V_2	43.29 – 48.57	45.80	40.33 – 47.96	44.36
	Ramaraogudem B_3V_3	45.59 – 50.26	48.19	44.11 – 49.60	46.89

Table 5.Soil pHof soil at different block of Eluru district, Andhra Pradesh

Block	Village	Soil pH	
		Range	Mean
Kaikaluru	Varahapatnam B_1V_1	6.98 – 7.20	7.08
	Tamarakollu B_1V_2	5.87 – 6.38	6.05
	Achavaram B_1V_3	6.70 – 7.00	6.80
Eluru	Sreeparru B_2V_1	7.54 – 7.93	7.69
	Madepalli B_2V_2	6.18 – 8.05	7.35
	Malkapuram B_2V_3	7.59 – 7.93	7.80
Denduluru	Denduluru B_3V_1	7.45 – 7.71	7.55
	Challachintalapudi B_3V_2	7.36 – 7.61	7.51
	Ramaraogudem B_3V_3	6.10 – 6.83	6.40

Table 6.EC (dS m^{-1}) and Organic Carbon (%) of soil at different block of Eluru district, Andhra Pradesh

Block	Village	EC of soil water suspension (dS m^{-1})		Organic Carbon (%)	
		Range	Mean	Range	Mean
Kaikaluru	Varahapatnam B_1V_1	0.46 – 0.58	0.50	0.52 – 1.60	1.01
	Tamarakollu B_1V_2	0.18 – 0.28	0.21	0.65 – 0.75	0.68
	Achavaram B_1V_3	0.32 – 0.87	0.52	0.30 – 0.52	0.40
Eluru	Sreeparru B_2V_1	0.57 – 0.73	0.67	0.49 – 0.52	0.51
	Madepalli B_2V_2	0.44 – 0.58	0.51	0.49 – 0.52	0.50
	Malkapuram B_2V_3	0.75 – 0.80	0.77	0.65 – 1.17	0.82
Denduluru	Denduluru B_3V_1	0.14 – 0.25	0.18	0.52 – 0.78	0.60
	Challachintalapudi B_3V_2	0.21 – 0.23	0.21	0.39 – 0.60	0.50
	Ramaraogudem B_3V_3	0.19 – 0.35	0.25	0.52 – 0.91	0.69

Table 7. Available Nitrogen (kg ha^{-1}), Phosphorus (kg ha^{-1}) and Potassium (kg ha^{-1}) of soil at different block of Eluru district, Andhra Pradesh

Block	Village	Available Nitrogen (kgha^{-1})		Available Phosphorus (kg ha^{-1})		Available Potassium (kg ha^{-1})	
		Range	Mean	Range	Mean	Range	Mean
Kaikaluru	Varahapatnam B_1V_1	250.0 – 325.0	283.3	70.0 – 94.0	84.6	26.0 – 31.0	28.3
	Tamarakollu B_1V_2	175.0 – 300.0	250.0	45.0 – 94.0	73.6	14.0 – 21.0	16.6
	Achavaram B_1V_3	250.0 – 350.0	283.3	35.0 – 62.0	50.3	27.0 – 30.0	28.6
Eluru	Sreeparru B_2V_1	120.0 – 250.0	203.3	37.0 – 83.0	57.0	64.0 – 77.0	69.0
	Madepalli B_2V_2	156.0 – 376.0	294.0	51.0 – 83.0	67.0	54.0 – 65.0	58.0
	Malkapuram B_2V_3	200.0 – 275.0	241.6	22.0 – 69.0	48.3	58.0 – 61.0	60.0
Denduluru	Denduluru B_3V_1	200.0 – 250.0	216.6	26.0 – 53.0	39.3	30.0 – 37.0	34.0
	Challachintalapudi B_3V_2	200.0 – 300.0	233.3	29.0 – 52.0	37.6	20.0 – 34.0	26.0
	Ramaraogudem B_3V_3	200.0 – 250.0	216.6	37.0 – 86.0	60.3	40.0 – 49.0	43.0

Table 8. Exchangeable Calcium andMagnesium (meq 100g^{-1}) of soil at different block of Eluru district, Andhra Pradesh

Block	Village	Exchangeable Calcium (meq 100g^{-1})		Exchangeable Magnesium (meq 100g^{-1})	
		Range	Mean	Range	Mean
Kaikaluru	Varahapatnam B_1V_1	6.90 – 7.80	7.30	0.20 – 0.30	0.26
	Tamarakollu B_1V_2	1.90 – 2.90	2.43	0.50 – 0.90	0.70
	Achavaram B_1V_3	2.00 – 3.40	2.86	0.60 – 1.00	0.80
Eluru	Sreeparru B_2V_1	3.51 – 5.18	4.26	0.80 – 1.30	1.06
	Madepalli B_2V_2	2.36 – 5.02	3.78	1.38 – 2.47	1.98
	Malkapuram B_2V_3	2.11 – 4.99	3.64	1.20 – 2.60	2.08
Denduluru	Denduluru B_3V_1	6.40 – 8.10	7.43	0.60 – 0.90	0.76
	Challachintalapudi B_3V_2	8.10 – 9.60	8.86	2.70 – 3.90	3.26
	Ramaraogudem B_3V_3	4.90 – 6.90	5.73	0.20 – 0.30	0.23

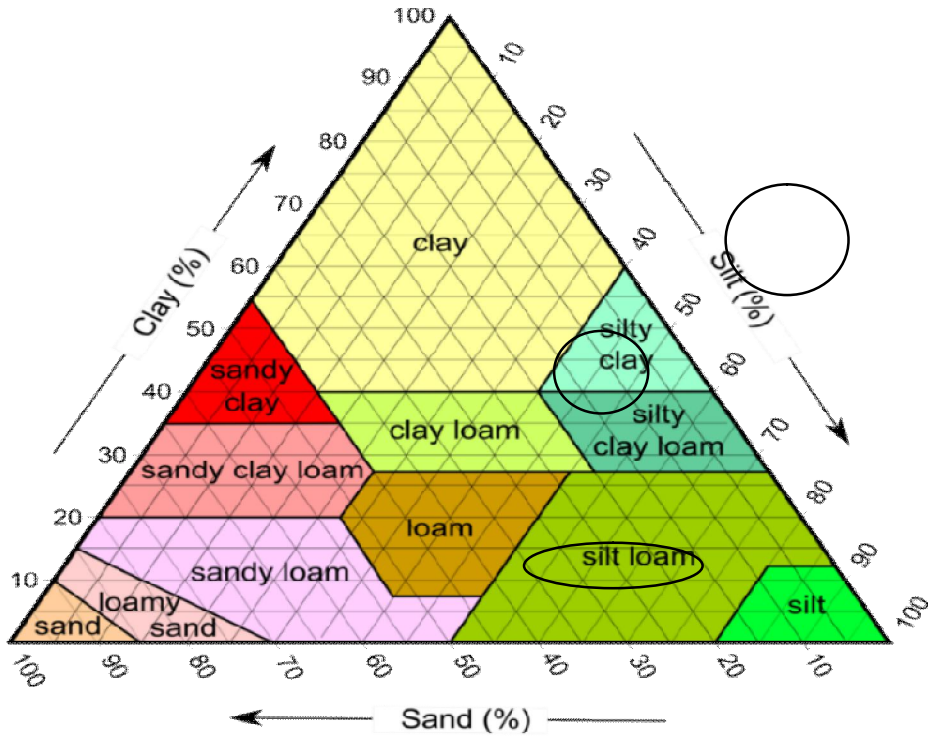


Fig. 1. The soil of textural triangle at different blocks of Eluru district

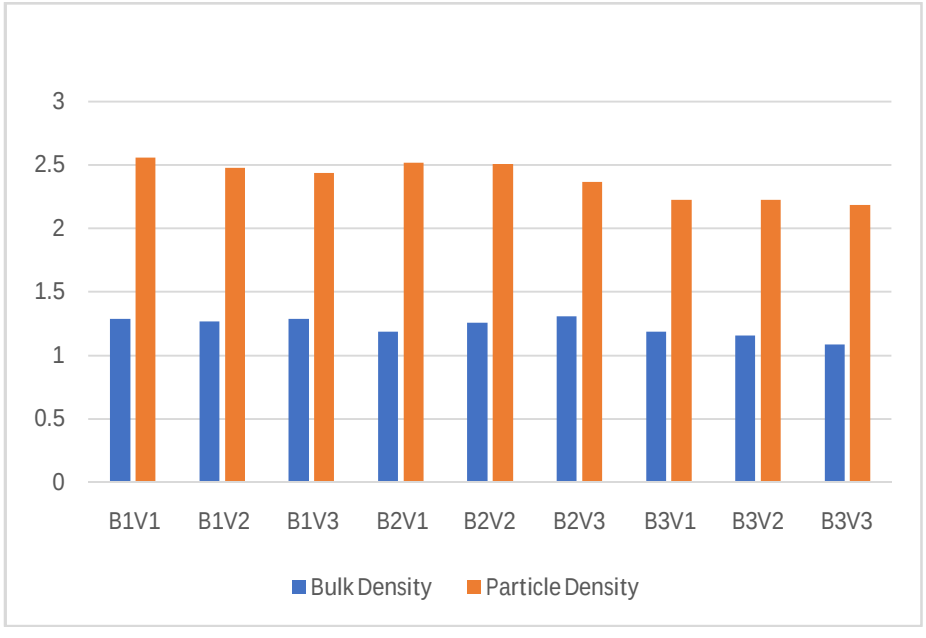
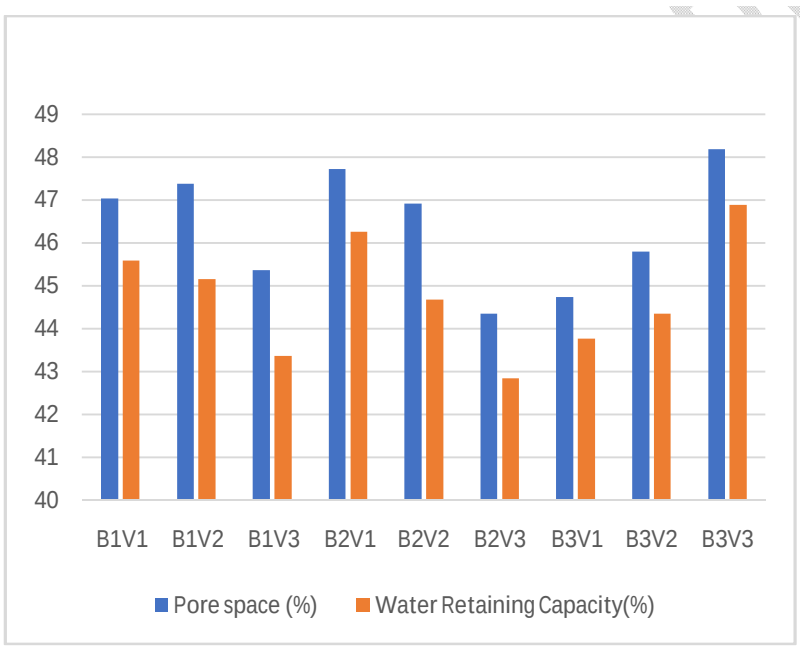
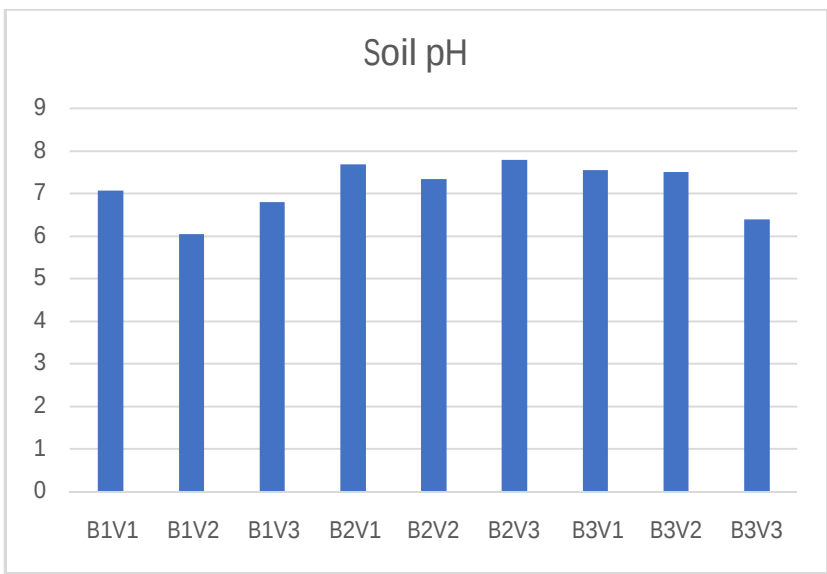


Fig. 3.Graphical representation of soil Pore Space (%) and Water Retaining Capacity (%) in different block of Eluru district, Andhra Pradesh

Fig. 2.Graphical representation of bulk density (mg m^{-3}) and particle density (mg m^{-3}) of soil in different block of Eluru district, Andhra Pradesh





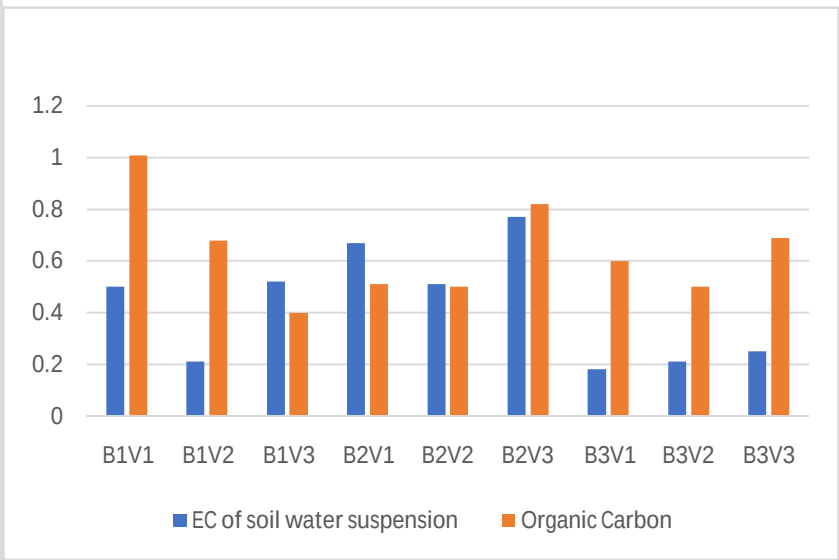


Fig. 4.Graphical representation of Soil pHin differentblockof Eluru district,Andhra Pradesh

Fig. 5.Graphical representation of EC (dS m^{-1}) andOrganic Carbon (%)different blockof Eluru district,Andhra Pradesh

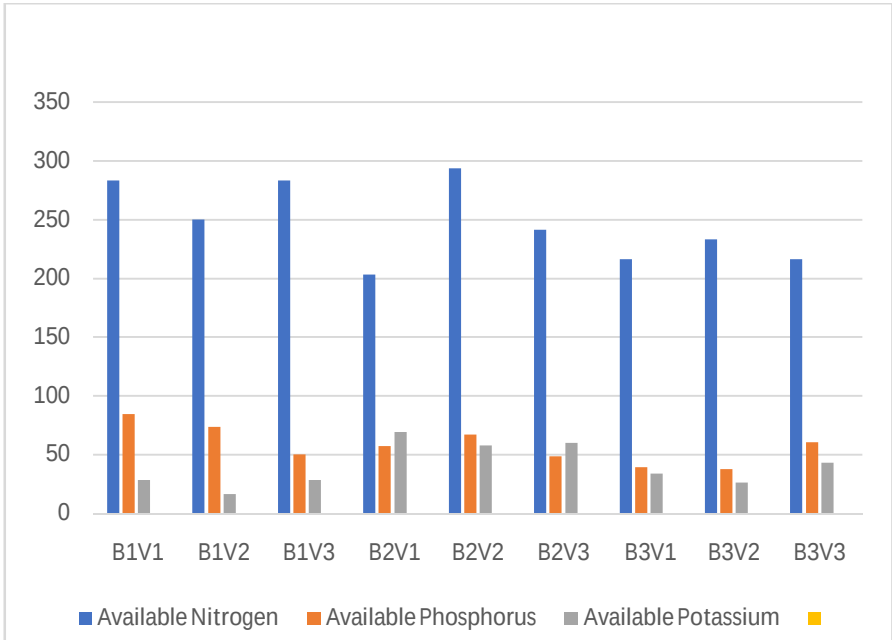
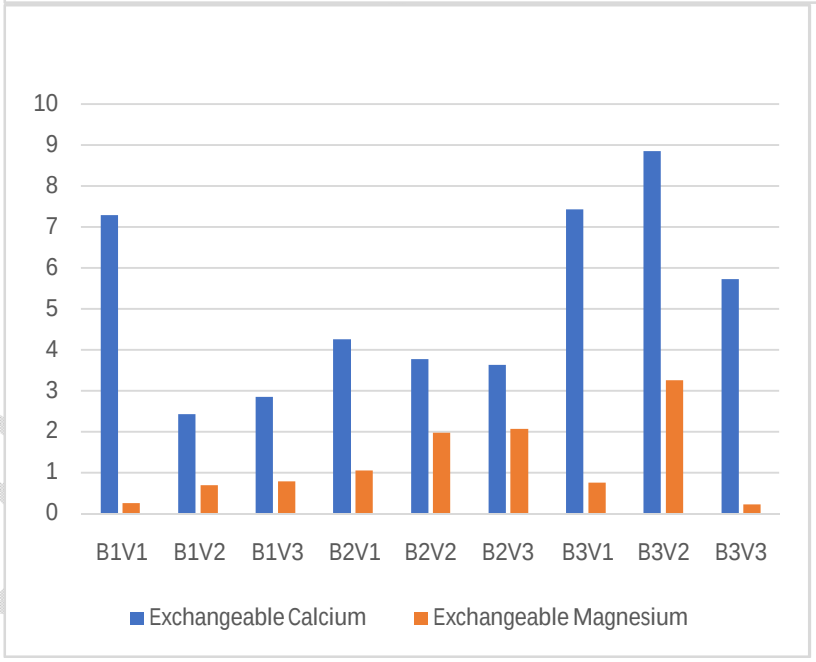


Fig.6.Graphical representation of available Nitrogen (kg ha^{-1}),Phosphorus (kg ha^{-1})and Potassium (kg ha^{-1}) ofSoil in different block of Eluru district,Andhra Pradesh



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4. CONCLUSION

From the above study the relationship between various physical and chemical parameters and their effect on soil quality was analysed. The soils of selected villages of different blocks in Eluru district were found to acidic to basic in nature. The soil colour of dry condition varies from greyish brown to yellowish red in 0-15 cm depth, from light brownish to red in 15-30 cm depth and from grey to red in 30-45 cm depth. The soil colour of wet condition varies from dark brown to dark red in 0-15 cm depth, from very dark to red in 15-30 cm depth and from very dark grey to red in 30-45 cm depth. The soil textural class was identified as sandy loam, clay and sandy clay. The bulk density and particle density increase with the increase in soil depth due to soil compactness. The water retainingcapacity of the soil and the overall physical condition of the soil was found good and supportive for plant growth. It is clear that the soils of selected villages of three blocks are acidic to basic in nature.The electrical conductivity of the soil ranged from 0.14 to 0.87 which is suitable for crop growth. The organic carbon content were observed as medium. Nitrogen and phosphorous content of the soil was medium to high. The potassium content were observed as low. Calcium and magnesium are sufficient in this soil. The deficiency of the nutrients can be mitigated by the use of organic and inorganic fertilizers.

5. Future Perspectives of the study

Future studies should focus on monitoring soil changes over time and seasonal variations to understand the impact of agricultural practices and climate change. High-resolution soil mapping and spatial distribution analysis can identify areas needing targeted interventions. Evaluating different agricultural practices and soil conservation techniques will help recommend best practices. Precision agriculture and organic amendments can improve nutrient management and soil fertility. Research on soil-plant interactions, crop diversification, and resilience to climate change will enhance soil and crop productivity. Identifying soil pollutants and developing remediation strategies are crucial for maintaining soil health. Engaging farmers through training and participatory research ensures practical implementation, while policy recommendations and incentive programs support sustainable soil management.

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