Original Research Article

Assessment of Physico-Chemical Properties of Soil from different Blocks of Prakasam District, Andhra Pradesh, India.

Abstract

The present research topic entitled “Assessment of Physico-Chemical parameters of soil from different blocks of Prakasam district, Andhra Pradesh" was carried out at the Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj. Department of Soil Science and Agricultural Chemistry (U.P.). During the year 2021-2022. In the present study Physico-Chemical analysis of soil in three blocks from nine in each hamlet, one farmer was chosen for sampling, and samples were taken at three depths: 0-15 cm, 15-30 cm, and 30-45 cm, for a total of 27 samples collected and analysed using conventional laboratory techniques. Bulk Density ranged 1.29 -1.46 Mg m^{-3}, Particle Density ranged 2.42-2.55 Mg m^{-3}, Percent of Pore Space varied 42.68-48.00 %, Water Holding Capacity varied 40.00-46.50 %, Specific Gravity varied 2.27-2.66. The pH ranged 6.42-9.04, EC ranged 0.16-0.35 dS m^{-1}, Organic Carbon varied 0.26-0.53 % and Available Nitrogen varied from low to medium 225-321 kg ha^{-1} Available Phosphorus varied from medium to high range 12.03-23.69 kg ha^{-1}. and Potassium was found to be medium range 135.62-234.65 kg ha^{-1}.

Comment [x1]: a single farmer's land

Comment [x2]: of

Comment [x3]: 27 samples

Keywords: *Physical, Chemical, parameters, Prakasam, Hamlet, Conventional, Andhra Pradesh etc.*

INTRODUCTION

Soil is a dynamic, 3-dimensional natural body of the landscape developed from the weathering of rocks through various pedogenic processes, composed of mineral and organic materials, processing a defined set of physical, chemical, and biological qualities, having a variable depth covering the earth's surface, and providing a medium for terrestrial plant growth (Verma *et al*., 2019). Soil is a dynamic natural body formed by pedogenic processes such as rock weathering, and it is made up of mineral and organic ingredients with specific chemical, physical, and biological properties. Physical, mineralogical, and biological properties that vary in depth over the earth's surface and provide a growing medium for plants

(Thakre *et al*., 2012). The rate of soil deterioration is influenced by land use patterns, soil types, terrain, and climate variables. Inappropriate land use is one of these variables that accelerates the deterioration of soil physicochemical and biological qualities (Singh *et al*., 1995).

Soil porosity is the percentage of total soil volume taken up by pore space. The amount of water that a specific soil can hold for crop usage is known as its water holding capacity. The pH of a soil determines its acidity or basicity. The EC measures the quantity of salts in soil. Organic Crabon is a component of soil organic matter that can be measured (Kekane *et al*., 2015).

Nitrogen (N) it plays a fundamental role in energy metabolism and protein synthesis and plant cannot complete its life cycle in absence of that particular nutrient. Cell membranes, protiens and nucleic acids all include Phosphorus (P). Potassium (K) It is a mineral that is required in the growing parts of the plants in large amounts.

Study Area

Prakasam District is located between the longitudes of $14^0$57' and $16^0$17' in the north and 78.43' and 80.25' in the east. The district has 102 kilometres of coastline that passes across eleven coastal mandals. Average Rainfall: 616 mm summer average temperature: 33.72°C. Average Winter Temperature: 24.08 ^{0}C. The crops grown in this region are rice, cotton, chickpea, tobacco, sorghum. The soils are diverse, with red soils accounting for 51.3 percent, black soils for 40.8 percent, sandy loam soils for 5.9%, and sandy soils for 2%.

MATERIALS AND METHODS

Soil Sampling

In Prakasam district covers 56 mandals, in that 3 mandals are covered in this study i.e., Podili, Darsi, Kurichedu. Nine villages in the district were chosen at random for sampling. Each farmer's field included three separate locations that indicated three different profile depths: 0-15 cm, 15-30 cm and 30-45 cm. A total of 27 samples were taken, with 9 representing a single farmer's land. At sampling site, soil samples were collected separately by a random selection from field with help of khurpi, metre scale, spade, and digging bar Following the collection of samples, the soil samples were air dried in the shade to avoid further chemical reactions. After the samples have dried, all undesired items such as roots, stones, and other foreign objects were removed. Large clods were crushed by wooden mallet. Grinding was followed by sieving for which 2.0 mm sieve was used. Physical and chemical

Comment [x4]: Not found in references
Comment [x5]: Not found in references
Comment [x6]: Carbon
Comment [x7]: proteins
Comment [x8]: meter

attributes were marked and sieved samples were stored in airtight polybags. Completely Randomized Design was used as the experiment design in the analysis (CRD).

ANALYSIS OF PHYSICO-CHEMICAL PROPERTIES

The hydrometer method was used to analyse the texture of soil particles less than 2 mm (Bouyoucos, 1927). The graduated 100 ml measuring cylinder method was used to determine Bulk density, Particle density, Pore Space, and Water Holding Capacity (Muthuvel *et al*., 1992). The relative density bottle or pycnometer method, as written out by Black, was used to determine the specific gravity of soil (1965). A digital pH metre was used to determine the pH, and the 1:2 soil water suspension method (Jackson, 1958). A digital EC metre was used to calculate the EC, and the 1:2 soil-water suspension method (Wilcox, 1950). The wet oxidation method was used to determine Organic Carbon (Walkley and Black, 1947). The alkaline Potassium permanganate technique was used to determine available Nitrogen (Subbiah and Asija, 1956). A colorimetric approach was used to determine available Phosphorus.ord (Olsen *et al*., 1954). The flame photometer method was used to determine the amount of accessible Potassium. (Toth and Prince, 1949).

RESULTS AND DISCUSSION

Soil Physical Properties

The experimental results of the present investigation entitled "Assessment of Physico-Chemical properties of soil from different blocks of prakasam district Andhra Pradesh, India." The colour (Dry method) of soil samples is shown Brown, Dark brown, Yellowish red, red, yellowish brown, reddish brown, Light olive brown, Dark reddish brown, Dark red and in (Wet method) colour of soil samples was shown Dark brown, very dark, yellowish brown, Brown, very dark greyish brown, Yellowish red, Red, Dark yellowish-brown, reddish-brown, Chahat Varma *et al*., (2019). The Soil Texture was sandy clay loam, sand content varied from 46- 84%, silt 10-24% and clay 22.6-31%, Das *et al*., (2018). Bulk density ranged 1.29-1.46 Mg m^{-3}. (P_2V_1) Kothapalli village reported lowest bulk density and (K_1V_3) Bodanampadu village reported highest Bulk density. Ahad *et al*., (2015) and the range of Particle density Mg m^{-3} varied 2.42-2.55 Mg m^{-3}. (P_2V_3) Akkacheruvu village reported lowest Particle density and (D_2V_3) Chalivendram village reported highest Particle density, Chaudhari *et al*., (2013). The range of Pore Space varied 42.68-48.00%. (K_1V_1) Avulamanda village reported low porosity and (P_2V_1) Kothapalli village reported high porosity, Choudhary *et al*., (2020) and the range of Water Retaining Capacity varied 40.00-46.50%.

Comment [x9]: Not found in references

Comment [x10]: Not found in references

Comment [x11]: black, 1965

Comment [x12]: delete this date

Comment [x13]: 1965

Comment [x14]: these results are similar to

Comment [x15]: Not found in references

Comment [x16]: as reported by

Comment [x17]: as reported by

Comment [x18]: these results are similar to

Comment [x19]: similar results showed by

Comment [x20]: Not found in references

The lowest Water Holding Capacity was observed in (K_1V_1) Avulamanda village highest Water Holding Capacity was observed in the (D_3V_3) Chalivendram village, Das *et al.*, (2018). Specific Gravity ranges from 2.27 -2.66. In (P_2V_3) Mallawaram village the highest Specific Gravity value was found. The lowest Specific Gravity value was observed in (K_1V_2) Alavalapadu village, Choudhary *et al.*, (2020).

Soil Chemical Properties

The pH of the soil samples is somewhat acidic to strongly alkaline in nature, with values ranging from 6.42 to 9.04. The highest pH value was observed in the (P_2V_1) Kothapalli village. Due to high rainfall which caused leaching of bases similar findings Basavaraja *et al.*, (2017). The lowest pH value was observed in the (D_3V_3) Chalivendram village. Meakanaboyina *et al.*, (2019) The Electrical Conductivity in the soil samples had a range of 0.16 to 0.35 dS m^{-1}. The village with the lowest EC content was (P_2V_3) Mallawaram, whereas the village with the greatest EC content was (K_1V_3) Bodanampadu. The results observed 100% of the soil samples are in permissible range suitable for most of the crops, (Basavaraja *et al.*, 2017) Organic Carbon levels ranged 0.26 - 0.53%. The results concluded that Organic Carbon range was low to medium range. The lowest Organic Carbon was observed in (K_1V_2) Alavalapadu and (K_1V_3) Bodanampadu villages whereas highest Organic Carbon reported in (P_2V_3) Mallawaram village Deshmukh *et al.*, (2012). The amount of available Nitrogen is low to medium. The Nitrogen varied 225.00-321.00kg ha^{-1}. The lowest Nitrogen content was reported in (K_1V_3) Bodanampadu village due to replenishment of soil Nitrogen through organics and or in organics to avoid soil mining for Nitrogen similar findings kumar *et al.*, (2007) whereas highest Nitrogen content in soil was observed in (P_2V_3) Mallawaram village Patel *et al.*, (2017). The amount of available Phosphorus is high. Because of excessive use of phosphatic fertilizers similar findings wagh *et al.*, (2013). The Phosphorus ranged from 12.03- 23.69 kg ha^{-1}. The lowest Phosphorus content was observed in (K_1V_1) Avulamanda village whereas highest Phosphorus was reported in (P_2V_3) Mallawaram village. Supriya *et al.*, (2019) The Potassium content is in medium range 135.62-234.65 kg ha^{-1}. The lowest Potassium content was observed in (K_1V_3) Bodanampadu village whereas highest Potassium content was reported in (D_3V_3) Chalivendram village Dinesh *et al.*, (2016).

Assessment of Correlation matrix between Physico-chemical parameters of soil in Podili, Darsi, Kurichedu blocks of Prakasam district, Andhra Pradesh.

The Bulk density of the soil has a favourable correlation with EC (r=0.57) and

Comment [x21]: as recorded by

Comment [x22]: as shown by

Comment [x23]: Not found in references

Comment [x24]: these results are similar to

Comment [x25]: Not found in references

Comment [x26]: as recorded by

Comment [x27]: 2017

Comment [x28]: Not found in references

Comment [x29]: Not found in references

Comment [x30]: Not found in references

Comment [x31]: Not found in references

Particle density (r=0.54). The Particle density of the soil has a substantial positive relationship with EC (r=0.57). The soil Pore Space is favourably linked with pH (r=0.73), Nitrogen (r=0.39), and Phosphorus (r=0.63). The capacity of the soil to hold water is positively associated with Nitrogen (r=0.42), Phosphorus(r=0.57), Potassium(r=0.55). The Nitrogen is positively significantly correlated with Phosphorus(r=0.60), Potassium(r=0.80). The Phosphorus is positively significantly correlated with Potassium(r=0.60)

CONCLUSION:

The soil analysis results were interpreted using the literature which help farmers and add the deficient nutrients. According to the soil test results of Kurichedu, Darsi, Podili blocks clearly states that the soil is in slightly Acidic to strongly alkaline in condition. 100% of soil samples are in permissible limit of EC suitable for most of crops. Most of the soil samples showed low-medium Organic Carbon content this is due to low and high temperature and less decomposition of organic matter in the soil. More than 50% are low to medium in Nitrogen, Phosphorus is in high whereas Potassium is in medium range. Based on results Soil and Health Card has prepared given to farmers. It suggests that still improvement can be done by improving cropping pattern, decomposition of organic waste, mulching and tillage practices with the knowledge and experience gained through study may be developed in future to help the farmers regarding the quality produce, high yields through soil conservation and maintain better environment protection.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

REFERENCE

Ahad, T., Kanth, T.A. and Nabi, S. (2015). Soil Bulk Density as Related to Texture, Organic Matter Content and Porosity in Kandi Soils of District Kupwara (Kashmir Valley), India. *International Journal of Scientific Research*, 4(1): 198-200.

Black, C. A., (1965) Methods of Soil Analysis Part – II. Chemical and microbiological properties. Agronomy Monograph No. 9. *American Society of Agronomy*, Inc. Madison, Wisconsin, USA, 18-25.

Black, C. A., (1965). Methods of Soil Analysis. Part I and II. *American Society of Agronomy, Inc., Madison, Wisconsin,* U. S. A., 1-2: 1572.

Basavaraja. P.K., Dey. P., Mohamed Saqeebulla. H. and Yogendra. N.D. (2017). Geo-reference Based soil fertility status in Hasan district of Karnataka, India for development of nutrient plan. Indian Journal of Soil conservation, 45: 141-147.

Bouyoucous, G.J., (1927) The hydrometer as a new method for the mechanical analysis of soils. *Soil Science* 23, 343-353.

Chaudari, P.R. and Ahire, D.V. (2014) Electrical and physical properties of Coimbatore soils at microwave frequency. *International Journal of Innovative Research in Science, Engineering and Technology*, 3(11): 17500-17504.

Jackson. M. L. (1973). Soil Chemical Analysis. *Prentice Hall of India Pvt. Ltd.,* New Delhi.

Chaudhari, P.R., Ahire, D.V., Ahire, V.D., Chakravarty, M. and Maity, S. (2013). Study of Soil bulk density as related to soil texture, organic matter contents and available total nutrients of Coimbatore soil. *International Journal of Scientific and Research publications*, 3(2): 1- 8.

Das. A., David. A.A., Swaroop. N., Thomas. T., Rao. S. and Hasan. A. (2018) Assessment of Physico-chemical properties of river bank soil of Yamuna in Allahabad city, Uttar Pradesh. International Journal of chemical studies 6(3): 2412-2417.

Deshmukh. K.K. (2012), Evaluation of Soil Fertility Status from Sangamner area, Ahmednagar district, Maharashtra, India. Research Journal on Chemistry, 5:3.

Jain, S.A., Jagtap, M.S. and Patel, K.P. (2014). Physico-Chemical Characterization of farmland Soil used in some villages of Luna Wada Taluka. Dist.: Mahi Sagar (Gujarat) India. *International Journal of Scientific and Research Publications,* 4 (3): 1-5.

Jackson, M. L. (1958) The pH was determined in 1:2 soil water suspensions using digital pH meter.

Comment [x32]: Not found in the manuscript

Comment [x33]: Not found in the manuscript

Comment [x34]: Not found in the manuscript

Kekane, S.S., Chavan, R.P., Shinde, D.N., Patil, C.L. and Sagar, S.S (2015) A review on physico-chemical properties of soil. International Journal of Chemical Studies 3(4): 29-32.

Kumar. A.S., Shirur.M. and Sharma. V.P. (2017). Assessment of Soil Fertility Status of Mid Himalayan Region, Himachal Pradesh. *Indian Journal of Ecology,* 44(2): 226-231.

Muthuval P., C.Udaysoorian, R. Natesan, P.P Ramaswami, (1992) Introduction to Soil Analysis, Tamil Nadu Agricultural University, Coimbatore-641002.

Olsen. S.R., Cole. C.V., Watanabe. F.S. and Dean. L.A. (1954). Estimation of Available Phosphorus in Soils by Extraction with Sodium Bicarbonate. U. S. Department of Agriculture, Circular No. 939.

Subbiah, B. V. and Asija, E.C., (1956) A rapid procedure for estimation of available Nitrogen in soil *Current Science* 25(8), 259- 260.

Supriya, (2021). India: Soil Types, Problems & Conservation. http://bhuvankosh.co

Singh. Y.V., Shashi Kant., Singh S.K., Sharma P.K., Jat., Kumar., Shahi. S.K., Jatav. H. S. and Yadav. R.N. (2017). Assessment of Physico-Chemical Characteristics of the Soil of Lahar Block in Bhind District of Madhya Pradesh (India). *International Journal of Current Microbiology and Applied Sciences,* 6(2): 511-519.

Srilakshmi, M., Thomas, T., Rao, P.S. (2019) Assessment of soil physico-chemical properties of near by coastal area paddy soils of Praksam ditrict, Andhra Pradesh. *International Journal of Chemical Studies*. 7(3): 1605-1608.

Toth, S. J. and Prince, A. L. (1949). Estimation of cation exchange capacity and exchangeable Ca, K and Na content of soil by flame photometer technique. Soil Sci., 67:439-445.

Comment [x35]: Not found in the manuscript

Comment [x36]: Not found in the manuscript

Comment [x37]: Not found in the manuscript

Comment [x38]: Not found in the manuscript

Verma, C., Lal, A., David A. D. M. and Rao, P. S. (2019). Determination of Physico-chemical properties in soil samples of Prayagraj (Allahabad) District, Uttar Pradesh, India. Asian Journal of Applied Chemistry Research, 4(2): 1-8.

Walkley. A. and Black. T. A. (1934). An examination of the Degt. Jarett method for determination of soil organic matter and a proposed modification of chromic acid titration. Soil Science, 37: 29-38.

Wilcox, L. V. (1950) Electrical conductivity Am. *Water works, Assoc. J*.42: 775-776

Table:1 Physical Properties

Sample No.	Bulk density(Mg m^{-3})			Particle density(Mg m-3)			Porosity (%)			Water Holding Capacity(%)			Specific Gravity		
	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	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
K_1V_1	1.4	1.41	1.42	2.46	2.48	2.49	43.08	43.14	42.97	42.52	41.55	40.55	2.62	2.59	2.56
K_1V_2	1.39	1.41	1.43	2.5	2.51	2.53	44.4	43.82	43.47	43.85	42.09	41.38	2.33	2.3	2.27
K_1V_3	1.42	1.43	1.44	2.51	2.53	2.54	43.42	43.47	43.08	44.71	43.05	42.36	2.64	2.61	2.58
P_2V_1	1.3	1.32	1.33	2.5	2.52	2.53	48	47.61	47.43	43.85	41.28	40.94	2.43	2.39	2.36
P_2V_2	1.31	1.33	1.35	2.49	2.5	2.54	47.38	46.8	46.85	44.76	42.77	42.83	2.54	2.51	2.48
P_2V_3	1.29	1.32	1.35	2.42	2.45	2.5	46.69	46.12	46	45.66	42.85	41.5	2.65	2.62	2.59
D_3V_1	1.4	1.43	1.44	2.5	2.53	2.54	44	43.47	43.3	44.82	41.88	40	2.64	2.61	2.57
D_3V_2	1.37	1.41	1.45	2.47	2.51	2.53	44.53	43.82	42.68	45.45	42.45	40.75	2.35	2.31	2.28
D_3V_3	1.37	1.42	1.46	2.52	2.53	2.55	45.63	43.87	42.74	46.5	43.88	43.42	2.66	2.63	2.58
	F-test	S.Ed. (+)	C.D.@5 %	F-test	S.Ed. (+)	C.D.@5 %	F-test	S.Ed. (+)	C.D.@5 %	F-test	S.Ed. (+)	C.D.@5 %	F-test	S.Ed. (+)	C.D.@5 %
Due to depth	NS	0.023	-	NS	0.02	-	S	0.48	0.03	S	1.62	0.008	S	0.03	4.05
Due to site	NS	0.047	-	S	0.024	0.008	S	1.75	8.3	S	0.92	0.009	S	0.13	1.61

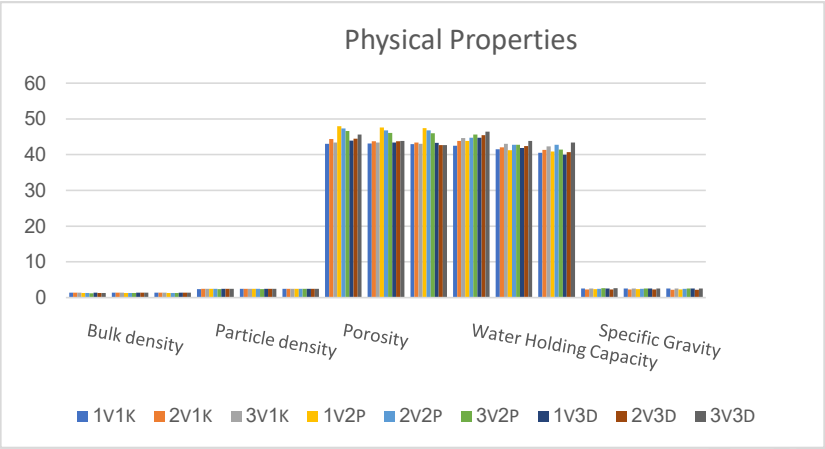
Table: 2 Chemical Properties

Sample No.	pH			EC (dS m^{-1})			Organic Carbon (%)			Nitrogen (kg ha^{-1})			Phosphorus (kg ha-1)			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	0-15	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
K_1V_1	6.61	6.71	7.1	0.24	0.26	0.31	0.33	0.31	0.28	242	236	229	16.44	14.42	12.03	211.98	196.65	171.14
K_1V_2	7.11	7.21	7.22	0.22	0.22	0.28	0.31	0.29	0.27	254	247	240	18.76	15.54	13.32	183.45	177.04	151.87
K_1V_3	6.91	6.92	6.93	0.29	0.32	0.35	0.32	0.29	0.26	233	225	214	17.86	13.24	12.13	166.05	145.23	135.62
P_2V_1	8.41	8.92	9.04	0.21	0.24	0.28	0.45	0.41	0.38	288	274	268	21.71	18.48	16.26	197.75	181.16	175.34
P_2V_2	6.92	8.2	8.22	0.19	0.22	0.25	0.48	0.44	0.41	275	263	257	19.9	15.68	13.45	201.75	183.19	174.09
P_2V_3	8.41	8.42	8.43	0.16	0.19	0.21	0.53	0.5	0.47	321	292	285	23.69	19.47	17.24	234.65	207.02	190.31
D_3V_1	6.73	7.31	7.42	0.18	0.2	0.23	0.46	0.42	0.4	303	288	275	18.28	17.05	14.83	225.07	195.94	171.18
D_3V_2	6.42	6.51	7.53	0.19	0.22	0.24	0.42	0.39	0.36	315	301	281	16.92	15.69	12.47	211.63	208.13	191
D_3V_3	6.53	6.63	6.7	0.22	0.26	0.32	0.47	0.44	0.41	296	285	273	17.96	15.72	13.04	229.34	218.65	197.46
	F-test	S.Ed. (+)	C.D.@5 %	F-test	S.Ed. (+)	C.D.@5 %	F-test	S.Ed. (+)	C.D.@5 %	F-test	S.Ed. (+)	C.D.@5 %	F-test	S.Ed (+)	C.D.@5 %	F-test	S.Ed. (+)	C.D.@5 %
Due to depth	NS	-	0.2	S	0.0318	0.0003	S	0.029	6.47	S	11.42	0.0005	S	2.6	1.22	S	16.87	0.0004
Due to site	S	0.77	0.00002	S	0.0405	0.0001	S	0.07	6.06	S	27.71	1.52	S	1.97	3.92	S	20.62	6.36

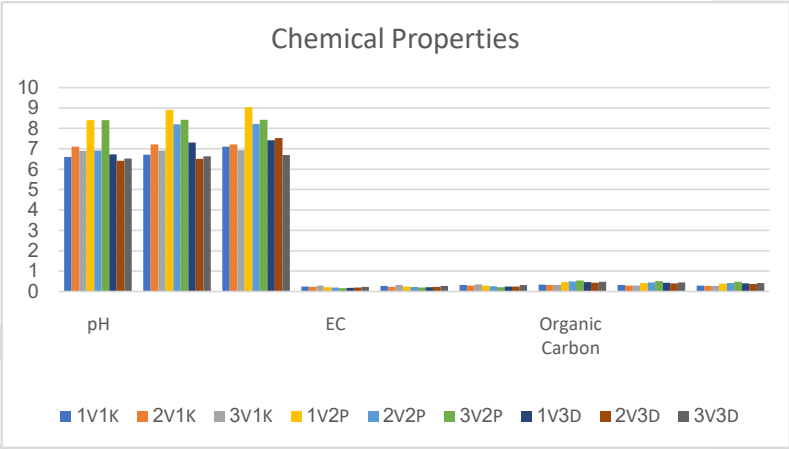
Table: 3 Assessment of Correlation matrix between Physico-Chemical parameters of soil in Podili, Darsi, Kurichedu blocks of Prakasam district, Andhra Pradesh.

	BD	PD	Pore Space	WHC	pH	EC	OC	N	P	K
BD	1									
PD	0.539974	1								
Pore Space	-0.94785	-0.24431	1							
WHC	-0.32227	-0.35443	0.238802	1						
pH	-0.66521	-0.09712	0.73099	-0.31162	1					
EC	0.574248	0.574722	-0.45261	-0.36275	-0.2019	1				
OC	0.050378	-0.30799	-0.17965	-0.03664	-0.18955	-0.01194	1			
N	-0.43378	-0.31825	0.389864	0.415196	0.167054	-0.78004	-0.1782	1		
P	-0.74963	-0.62115	0.633423	0.570559	0.330571	-0.74506	0.014125	0.601483	1	
K	-0.35797	-0.53731	0.217634	0.550546	-0.11654	-0.719	0.185651	0.800264	0.597168	1
Cu	-0.69761	-0.41161	0.642401	0.108254	0.533759	-0.17054	0.106234	-0.23101	0.453336	-0.1869
Zn	-0.00449	0.284649	0.109891	0.507185	-0.2087	0.24597	-0.0312	-0.16437	0.196064	-0.0482
Fe	-0.08815	-0.22544	0.023726	0.458806	-0.13331	-0.33685	-0.13479	0.698995	0.243964	0.631673

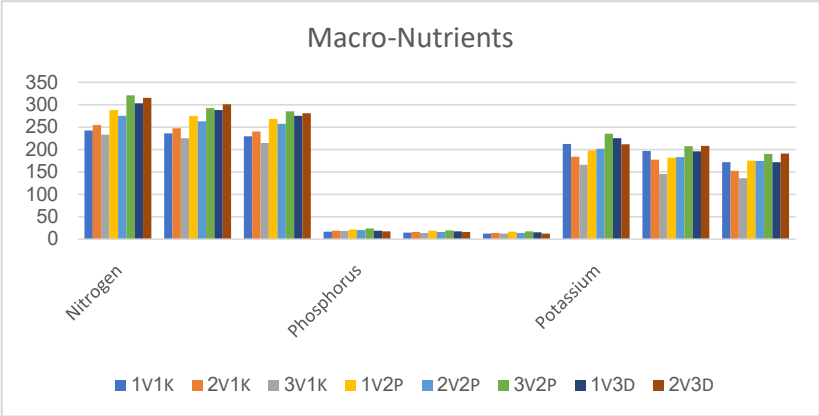
Note: - significant at 0.05 level



Graph:1 Physical Properties



Graph:2 Chemical Properties



Graph-3 Macro-Nutrients