Environment and Ecology 40 (4) : 2140—2147, October—December 2022
ISSN 0970-0420

Assessment of Soil Fertility Status in Different Villages of Kovur Block, Nellore District of Andhra Pradesh, India

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Received 9 June 2022, Accepted 21 July 2022, Published on 19 October 2022

ABSTRACT

The study was conducted on soil quality of different Villages in Kovur Block of Nellore District, Andhra Pradesh. Nellore is a place which is well known for Sriharikota rocket center of India. In this study soil samples are collected from 0-15cm depth of different field lands and in kovur Block. The results show that BD, PD, Porosity and water holding capacity of soils are 1.14-1.6, 2.19-2.91 g/cm^{-3}, 0-53.80 and 31.57-49.32% for soil quality organic carbon, and primary nutrients plays a major role. The results obtained in this analysis are organic carbon ranged from 0.25 -1.97% while primary nutrients are of N, P, K –12.50-213.24 kg/ha, 27.03 -46.68kg/ha and 145.6-548.8 kg/ha. The soils of the kovur block have low in accessible nitrogen and sulfur, high in phosphorus, medium in potassium and organic carbon. The current study is expected to help the farmers of Kovur block in guiding techniques required for long-term soil fertility management and creating future agricultural research strategies on the farm.

Keywords Soil fertlity, Physico-chemical properties, Primary nutrients, Micronutrients.

INTRODUCTION

Soil is a free asset to every life on the planet, as well as a source of sustenance and will continue to be so in the future. It is a dynamic natural body found on the earth's outermost solid layer (Crust). It is made up of a vertical succession of layers (Soil Horizons) that are made up of weathered mineral components (45%), organic matter (5%), soil air (25%) and soil water (25%). Soil is the result of the long-term effects of temperature, terrain and organisms (flora and fauna, humans) on parent material (initial rock and mineral). As a result, the texture, structure, consistency, chemical, biological and physical features of this soil differ from those of its parent material. It serves as a natural substrate for plant growth as well as a water and nutrient reservoir. Soil has a wide range of chemical, biological, and physical properties, and processes like leaching, weathering and microbial activity combine to produce a variety of soil types such as acidic, saline and alkaline soils. For agricultural output,each variety has distinct strengths and weaknesses. Soils are ecosystem service providers' soils store and deliver water to plants while also preventing floods by slowly transporting water to streams and ground water. Pollutants are filtered and remedied by them. They recycle nutrients and trash

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by cycling them. Changing them into biologically useful forms and storing them for future use. Soils are home to a diverse range of organisms (Manna *et al*. 2006). They regulate gas emissions by absorbing and releasing vital gases such as oxygen and green house gases. One of humanity's greatest concerns in the twenty-first century is the protection, restoration and maximization of ecosystem services given by soil.

Soil quality and soil health although the two terms are often used inter changeably, it is important to note that it can be defined as a soil's ability to function within its capacity and within natural or managed ecosystem boundaries in order to sustain plant and animal productivity, maintain or exchange water and air quality and support human health and habitation. It is defined as the soil's ability to function as a vibrant living system within eco-system and land-use boundaries in order to maintain biological productivity, maintain or improve air and water quality and promote plant, animal and human health (Singh *et al*. 2016). Soil quality varies slowly owing to natural processes like weathering and more quickly due to human activities like land usage and farming techniques, all of which can increase or deteriorate soil quality. It has both static and dynamic properties. Sandy soil drains faster than clayey soil, for example. Inherent soil quality is the natural ability to function. These properties are difficult to change, and dynamic soil quality refers to how soil changes as a result of how it is maintained. Management decisions have an impact on soil organic matter, soil structure, soil depth, and water and nutrient holding capacity. Wind and water erosion, organic matter loss, soil structure disintegration, salinization, and chemical contamination all degrade soil health. Soil fertility and soil productivity are two more synonyms (Rajendiran *et al*. 2020). Soil fertility refers to the soil's inherent ability to provide all essential plant nutrients in readily available form and in a suitable balance, while soil productivity refers to the soil's ability to produce a specified crop yield under well-defined and specified input and environmental management systems. These nutrients are required for plants to complete their life cycle, metabolic processes and chemical processes that occur within living organisms such as photosynthesis. These components are required for the plant to develop and reproduce. Because carbon, oxygen, and hydrogen are available through air and water, they are classified as non-mineral elements (Sharma *et al*. 2021). The macro and micro nutrients are separated into two categories. Macro nutrients are those that are required in significant amounts and include (C, H, O, N, P, K, Ca, Mg and S). Some are available through the atmosphere and water, while the others are divided into-Plant growth is impossible without the primary nutrients N, P and K, which are required in considerable quantities. Ca, Mg and S are secondary nutrients that are required in moderate amounts (Kumar and sinha 2010). Micronutrient deficiencies are more common in highly leached sands, organic soils and extremely alkaline soils because they are required in lesser amounts. When micronutrients are present in large levels, they can be toxic or damaging to plant growth. There are a few aspects that do not match the exact definition of essential but are nonetheless crucial. These elements are either required by some plant species but not all, or are extremely advantageous to plant growth. Perhaps this is useful for determining the block fertility level; but, to get a comprehensive picture of the soil fertility condition of a region/block, a significant number of samples from throughout the area must be evaluated. This will be beneficial for planning and implementing policies related to nutrient/fertilizer management in the area. In light of the above, a significant number of soil samples were collected from the Kovur block in Nellore region for this research and soil fertility status was assessed for macro and micro-nutrients. Furthermore, variability in soil fertility status at the block level was illustrated and described. An effort has also been made to correlate soil nutrient content with main soil parameters.

MATERIALS AND METHODS

Description of the study area

Nellore is one of Andhra Pradesh's nine coastal districts, located in the state's south eastern corner. It is a significant agricultural district. It has abundant rainfall and surface water. On the east, the district is bordered by the Bay of Bengal, which runs for 163 kilometers. Sriharkota Island is home to India's famed and only satellite launch center, known as SHAR. Nellore, Gudur and Kavali are the three rev-

Table 1. Description of sampling sites.

Sl. No.	Name of village	Land type
1	Gummaldibba	Cultivated Paddy
2	Pattur	Cultivated Paddy
3	Yellayapalem	Cultivated Paddy
4	Rajupalem	Cultivated groundnut
5	Kovur	Cultivated Paddy
6	Gangavaram	Cultivated Paddy

enue divisions of the district. There are 46 revenue mandals in these divisions. The district's soils are divided into three categories: Black, red and sandy. Red soil covers 40 % of the land in the area, while as and belt runs parallel to the ocean's edge. The dark cotton soil and sandy top soils each have 23 % and 34 % of the zone, respectively. The mineral silica sand is found across the coastal settlements, reaching 35 kilometers long and 12 kilometers wide and covering around 42000 hectares. Agriculture grounds, habitations, and forest land covered the majority of the silica sand yielding area. Silica mines have been assigned to a vacant area of barren terrain with sand dunes that is undulated and unsuitable for agricultural purposes. Quartz, mica, feldspar, laterite and vermiculite are the minerals. Kovur is a Block 6 kms near to Nellore district, which is well known for ISRO (Rocket center). It is located at 14.50^{o}N to 79.98^{o}E altitude. The Block is famous for penna river, temples and handmade silk sarees. This area is situated in east costal region near to Bay of Bengal. Due to situated near Bay of Bengal the climate is hot and humid with extreme temperature of (21-40^{o}C) and on rainfall of about 524 mm in a year. The average annual temperature for Kovur is 30^{o}C and it is dry for 140 days a year with an average humidity of 77 %. Onset of monsoon takes place from July to august of south-west monsoon and November-December of north-east monsoon. Summer season starts from April starting week and continues up to July. May is the warmest month with an average temperature of about 40.30^{o}C whereas coldest month of the block is January and February with average temperature of 21^{o}C. Description of sampling sites in Table 1.

Soil sampling and laboratory analysis

All samples of soil collected randomly from 6 different sites by making V-shape at depth of 15cm. At first remove stones and surface liter in sampling spot itself, collect five-six representative samples in zig-zag pattern to ensure homogeneity. On an average 2 to 3 kg of sample were collected and thoroughly mix together and reduce up to 1 kg by quartering in to a composite sample. The collected soil samples were kept in shade for air drying, at normal room temperature, after complete drying take to laboratory for further processing. Dried samples were crushed with the help of wooden roller. Later, samples were sieved by using 2mm mesh sieve. After sieving samples were stored in plastic bags with labeling on it like collection of data and time were specified. Labeled samples were finally analyzed for physico-chemical

Table 2. Procedure used for physical and chemical analysis of soil.

Properties	Method applied	Reference
Physical properties		
Bulk density (Mg kg^{-1})	Pycnometer	Black *et al*. (1965)
Particle density (Mg kg^{-1})	Pycnometer	Black *et al*.(1965)
Water holding capacity	Keen box	Piper (1966)
Chemical properties		
pH	Glass electrode pH meter	Jackson (1973)
EC (dSm^{-1})	Electrical conductivity meter	Jackson (1973)
Organic carbon (%)	Wet oxidation method	Walkey and Black (1934)
Available nitrogen	Alkaline Potassium permanganate	Subbiah and Asija (1956)
Available phosphorus	Modified Olsen's method	Olsen (1954)
Available potassium	Extractable K_2O ammonium acetate	Schollenberger and Simon (1945)
Exchangeable calcium and magnesium	EDTA titration method	Jackson (1973)
Available sulfur	Turbidimetric method	Chesnin and Yien, (1950
Cationic micronutrient	DTPA solution by Atomic	Lindsay and Norvell (1978)
Zn, Fe, Cu and Mn (mg/kg)	Absorption spectrophotometer	

properties (Table 2).

Statistical analysis

The relationship between different soil characteristics and micronutrient contents in soils and plants were determined using correlation coefficients:

$$r = \sqrt{\frac{SP\ (x, y)}{SS(x),\ SS(y)}}$$

Where,

r = Correlation coefficient,
SP (xy) = Sum product of x, y variables,
SS (x) = Sum of square of x variable,
SS (y) = Sum of square of y variable.

RESULTS AND DISCUSSION

Physico-chemical properties

The pH values represents, the combined effect of acid-base reactions occurring in the soil environment (Mokolobate and Haynes 2002).The pH of the soil samples ranged from 6.1-8.4 with the mean value of 7.3. The values of standard deviation and coefficient of variation were 0.72 ± and 7.21 % respectively. The data revealed that 40% of samples are acidic in nature, 26.6 % of the samples are neutral and16.6% of the samples are alkaline in nature. The pH of the study area is somewhat acidic in nature. The EC of the soil samples varied from 0.112-0.965 dSm^{-1} with an average value of 0.45 dSm^{-1} and SD of 0.27 ±, CV 0.59 %. The result shows that 92.3% of the samples are in permissible range are similar results by (Bharteey *et al*. 2017). The organic carbon content of soil samples ranged from 0.25-1.97 % with the average value of 0.87% the SD ±0.43 and CV of 5%.The values of standard deviation and coefficient variation of organic carbon were. Out of 30 samples collected from Kovur block, 26.6 % of the soil samples are in low organic carbon content, 20 % of soil samples are in medium organic carbon content and 53.3 % of the soil samples are in high organic carbon content in Table 3. Similar results are observed in Mishra *et al*. (2019).

The values of Bulk density of soil samples ranged from 1.14-1.60 Mg m^{-3} with the mean value of 1.34 Mg m^{-3}.The standard deviations and coefficient of variation of bulk density were± 0.08 and 5.43 % respectively. Similar results were observed in Singh *et al*. (2015). This reveal that high amount of organic matter results in low compaction of soil, hence less will be the bulk density of the soil. Such results were also recorded by Singh (2019). The values of particle density ranged from 2.19-2.91 Mg m^{-3} with the mean value of 2.56 Mg m^{-3}. The standard deviation and coefficient of variation of particle density were ±0.18 and 5.37 % respectively in Table 3. The water holding capacity of the soil samples ranged from 31.57-49.32% with the average value of 41.2 %. Such results were also recorded by Singh *et al*. (2021). This reveals that WHC of soil increases with increasing level of organic carbon content and increasing percentage of clay and slit particles in the soil as silt and clay particles have much higher surface area than sand particles to hold more amount of water. Similar results are observed in Singh *et al*. (2017).

Status of macro nutrients

The perusal data presented in Table 4 revealed, the nitrogen content of the soil samples ranged from12.5-213.24 kg ha^{-1} with mean value of 90.73 kg ha^{-1}. Out

Table3. Soil Physico-chemical parameters of different villages of Kovur block of Nellore District in Andhra Pradesh.

Soil parameter	Mean	Range	SD±	CV(%)
Bulk density (Mg m^{-3})	1.34	1.14-1.6	0.08	5.44
Particle density (Mg m^{-3})	2.56	2.19-2.91	0.18	5.38
Water holding capacity (%)	41.2	31.57-49.32	4.56	28.91
Porosity (%)	37.5	0-53.8	19.5	3.97
pH	7.30	6.1-8.4	0.72	7.21
EC (dSm^{-1})	0.45	0.112-0.965	0.27	27.0
Organic carbon (%)	0.87	0.25-1.97	0.43	43.0

Table 4. Nutrient rating of the soil test values.

Parameters	Low	Medium	High
Organic carbon(%)	<0.5	0.5-0.75	>0.75
Available N (kg/ha)	<280	280-560	>560
Available P (kg/ha)	<12.5	12.5-25	>25
Available K (kg/ha)	<135	135-335	>335
Available S (kg/ha)	<10	10-20	>20
	Deficient	Sufficient	
Magnesium (Meq/100g)	<1.5	>1.5	
Calcium (Meq/100 g)	<1.0	>1.0	

of total soil samples collected 100% soil samples are low in nitrogen content. Similar findings were also reported in Visakhapatnam district of Andhra Pradesh (Desavathu *et al*. 2018).

The values for available phosphorus content in soil samples ranged from 27.03-46.68 kg ha^{-1} with the average value of 37.76 kg ha^{-1} out of 30 soil samples collected, it was found that 100 of soil samples were in medium range and were in high range in phosphorus content and majority of the samples of the study area are high in available phosphorus and can be consider suitable for crop production. Similar results were observed by (Desavathu *et al*. 2018). The values of available potassium content in soil samples ranged from145.6-548.8 kg ha^{-1} with the average value of 315.80 kg ha^{-1}. Here 33.3 % of samples are in high potassium content. Similar were observed in (Asadi *et al*. 2008).

The calcium content of soil samples ranged from 2.96-32 Meq $100g^{-1}$ with the mean value of 15.07 Meq $100g^{-1}$ with SD of ± 7.84 and CV of 0.52 % in Table 5. The values of standard deviation and coefficient of variation for calcium were ±7.84 and 0.52 % respectively. 100 % of soil samples were in high levels of calcium content. The magnesium content of the soil samples ranged from 1.9-93 Meq 100 g^{-1} with the mean value of 39.7 Meq$100g^{-1}$. Similar results are observed in Sharma *et al*. (2016). The data showed that the magnesium content of all the samples (100%) were in high range. The sulfur content of soil samples ranged from 0.26-15.35 mg kg^{-1} with the average value of 7.22 mg kg^{-1}. 80 % of the soil samples were in low range of sulfur and only 20% samples were in medium range in Table 5. Similar results are observed by Singh (2019).

Micronutrients (Fe, Cu, Mn and Zn)

The DTPA-iron content in the soil samples ranged

Table 5. Status of available macro-nutrients viz., Ca, Mg, S in soils of Kovur block.

Soil parameters	Range	Mean	SD±	CV(%)
Calcium (Meq$100g^{-1}$)	2.96-32	15.07	7.84	75.80
Magnesium (Meq$100g^{-1}$)	1.9-93	39.70	27.1	63.42
Sulfhur mg ($kg^{-1)}$	0.26-15.35	7.22	3.80	49.73

Table 6. Status of available micro-nutrients viz., Fe, Zn, Mn and Cu in soils of Kovur block.

Soil parameters	Range	Mean	SD±	CV(%)
Available Fe (mg kg^{-1})	0.21-6.1	1.6	1.7	102
Available Mn (mg kg^{-1})	0.12-4.7	1.37	1.07	7.8
Available Zn (mg kg^{-1})	0.04-0.89	0.37	0.21	5.8
Available Cu (mg kg^{-1})	0.13-3.67	0.38	0.65	16.9

from 0.21-6.10 mg kg^{-1} with an average value of 1.37 mg kg^{-1}. It was found that 86.6 % of soil samples are in low concentration of iron. The DTPA- manganese content in soil samples ranged from 0.12-4.70 mg kg^{-1} with a mean value of 1.37 mg kg^{-1}. It was found that 96.60 % of samples were deficient in Mn content (as per critical limit suggested by Lindsay and Norvell (1978) (Table 6).

The DTPA- Zn content in soil samples ranged from 0.04-0.89 mg kg^{-1} with a mean value of 0.37 mg kg^{-1}. The values of standard deviation and coefficient of variation were 0.21± and 5.8 % respectively. It was found that 83.3 % of samples were deficient in Zn content (Sharma *et al*. 2010). The DTPA- Cu content in soil samples ranged from 0.13-3.67 mg kg^{-1} with a mean value of 0.38 mg kg^{-1}. It was found that 60% of samples were deficient in Cu content.

Soil nutrient index

To compare the levels of soil fertility in different areas, a single value for each nutrient has to be calculated using the nutrient index proposed by Parker *et al*. (1951). The nutrient index is a three-tiered system for determining soil fertility based on the percentage of samples in each of the three classifications (low, medium and high).The nutrient index values of Kovur block were low of Nitrogen, phosphorus, zinc, manganese and iron, medium for potassium and organic carbon and copper. The nutrient index values for macro and micro nutrients of soil samples are given in Table 7. The NI was evaluated for the soil samples analyzed using following formula:

Nutrient Index (N.I.) = (NL × 1 + NM × 2 + NH × 3) / NT

Where,

NL: Indicates number of samples falling in low class

Table 7. Nutrient index values of Kovur block in Nellore district of Andhra Pradesh.

Sl.No.	Available nutrient	Nutrient index values	Category
1	Nitrogen	1.0	Low
2	Phosphorus	3.0	High
3	Potassium	2.3	Medium
4	Sulphur	1.2	Low
5	Organiccarbon	2.2	Medium

of nutrient status,
NM: Indicates number of samples falling in medium class of nutrient status,
NH: Indicates number of samples falling in high class of nutrient status
NT: Indicates total number of samples analyzed for a given area.

Correlation matrix between physico-chemical properties of soil

The perusal data presented in Table 8 revealed, the pH of soil was observed positive and strongly significant related with porosity (r=0.395) of soil. It is positively non-significant related with particle density (r =0.015), potassium (r=0.19), magnesium (r =0.179) and sulfur (r =0.32) of soil where as it is negatively non-significant with EC (r=-0.33), BD (r=-0.03), WHC (r=-0.012), OC (r=0.09), Nitrogen (r=-0.20), phosphorus (r=-0.12) and calcium (r=-0.24) of soil. The organic carbon of soil was positively significant with potassium (r=0.505*) of soil. It is positively non-significant related with Nitrogen (r=0.102), phosphorus (r = 0.139) of soil while negatively non-significant with Magnesium (r = -0.214) of soil. Similar findings were observed by Sachin *et al*. (2021). The primary macro nutrients of soil i.e., Nitrogen in soils of Kovur block was found negative significant related to Potassium (r = 0.141**) and significantly related with calcium (r=0.03*) of soil. It is positively non-significant related with Phosphorus (r=0.163), magnesium (r=0.251) and sulfur (r=0.062) of soil. Phosphorus of soil was positively non-significant related with Calcium (r =0.077), potassium (r=0.033) and Sulfur (r = 0.006) of soil whereas it is negatively non-significant with Magnesium (r=-0.278) of soil. Potassium of soil was positively non-significant related with Magnesium (r =0.238) of soil while it is negatively non-significant with Calcium (r = -0.212) and Sulfur (r=0.091) of soil. The secondary macronutrients i.e., Calcium of soil was found negative and non-significantly related to Magnesium (r =-0.217) and positively non-significant related with Sulfur (r=0.093) of soil. Magnesium of soil was positively non-significant related with Sulfur (r=0.114) of soil. Similar results were observed by Sharma *et al*. (2021).

CONCLUSION

Soil testing is a low-cost way to learn about a soil's ability to support crop growth. Growers who under-

Table 8. Correlation matrix between physico-chemical properties of soil of different villages of Kovur block of Nellore district, Andhra Pradesh. Note: '*' represents significant at 0.05 levels, '**' represents significant at 0.01 level.

	pH	EC	BD	PD	Porosity	WHC	OC	N
pH	1							
EC	-0.338	1						
BD	-0.034	-0.3127	1					
PD	0.0156	0.2204	0.2143	1				
Porosity	0.3957*	-0.1941	0.162	0.1897	1			
WHC	-0.103	-0.172	-0.004	-0.003	0.021	1		
OC	-0.098	-0.0416	0.0442	-0.187	0.147	0.034	1	
N	-0.202	0.1192	0.0978	-0.014	-0.401*	-0.206	0.1026	1
P	-0129	-0.1017	-0.059	-0.049	-0.266	0.334	0.1395	0.1639
K	0.1985	-0.0112	0.1897	-0.123	0.202	0.252	0.5059*	-0141
Co	-0.246	0.3136	0.1346	0.059	-0.205	0.0032	-0.0167	-0.037
Mg	0.1793	0.0056	-0.007	-0.217	0.2193	-01225	0.2143	0.2514
S	0.3282	-0.2956	0.0274	0.123	0.2396	-0.1227	-0.0338	0.0624
Cu	0.0187	-0.1472	-0.014	-0.444*	0.0696	-0.2532	0.3002	-0.069
Mn	0.0988	-0.0654	-0.202	-0.166	0.3069	0.1051	0.2959	0.2198
Fe	-0.164	0.0575	0.1405	-0.172	-0.0152	-0.009	0.2039	0.1893
Zn	-0.113	0.3238	0.0668	0.2296	0.0608	-0.009	-0.3453	-0.042

Table 8. Continued.

	P	K	Co	Mg	S	Cu	Mn	Fe	Zn
pH									
EC									
BD									
PD									
Porosity									
WHC									
OC									
N									
P	1								
K	0.0335	1							
Co	0.0779	-0.009	1						
Mg	-0.273	0.2385	-0.2171	1					
S	0.0007	-0.091	0.03952	0.1447	1				
Cu	0.0716	0.1657	-0.0796	0.0191	0.06715	1			
Mn	0.3026	0.3279	-0.2897	0.2483	-0.0372	-0.0103	1		
Fe	-0.139	0.1283	-0.1509	0.1228	-0.1646	0.2127	-0.0888	1	
Zn	-0.112	0.1865	0.22063	0.0291	0.23846	-0.0827	-0.0865	-0.2947	1

stand what each soil test value implies can make better crop input decisions, reducing risk and increasing profitability. To aid farmers in analyzing and supplementing lacking nutrients, the soil test results were analyzed utilizing literature. According to the fore going findings, the soils of Kovur Block are acidic in nature, and crop salinity is not a problem. Using the study region's soil nutrient index, it was discovered that the soils of the Kovur block were low in accessible nitrogen and sulfur, high in phosphorus, medium in potassium and organic carbon. Deficient nutrients can be supplemented to prevent deficiency in crops and to improve the efficiency of other nutrients. The key to long-term soil fertility control is integrated nutrient management.

REFERENCES

Asadi SS, Azeem S, Prasad AVS, Reddy MA (2008) Analysis and mapping of soil quality in Khandaleru catchment area using remote sensing and GIS. Curr sci, pp 391-396.

Bharteey PK, Singh YV, Sharma PK, Sukirtee, Rai KA, Kumar M (2017) Available micro-nutrient status and their relationship with soil properties of Narayanpur Block, District Mirzapur, Uttar Pradesh, India. *Int J Curr Microbiol Appl Sci* 6(7): 2838-2843.

Black CA (1965) Soil plant relationship. 2nd ed.n Publ New York, USA, pp 515-516.

Chesnin L, Yien CH (1950) Turbidimetric determination of available sufhur. In Proceeding Soil Sci Soc Am, pp 149.

Jackson MN (1973) Soil chemical analysis. Prentice Hall of India Pvt Ltd, New Delhi.

Kumar N, Sinha DK (2010) Drinking water quality management through correlation studies among various physico-chemical parameters: A case study. *Int J Environ Sci* 1(2): 253.

Lindsay WL, Norvell WA (1978) Development of DTPA soil test for zinc, iron, manganese and copper. S*oil Sci Am Proc* 42: 421-428.

Manna MC, Swarup A, Wanjari RH, Singh YV, Ghosh PK, Singh KN, Saha MN (2006) Soil organic matter in a West Bengal Inceptisol after 30 years of multiple cropping and fertilization. *Soil Sci Soc Am J* 70(1): 121-129.

Mishra Dipanjali, Singh YV, Sukirtee (2019) Micronutrients status and their relationship with soil physico-chemical properties of Naugarh block, Chandauli District, Uttar Pradesh, India. *J Pharmacog Phytochem* 8(4): 528-531.

Mokolobate MS, Haynes RJ (2002) Increases in pH and soluble salts influence the effect that additions of organic residues have on concentrations of exchangeable and soil solution aluminium. *Europ J Soil Sci* 53(3): 481-490.

Olsen SR (1954) Estimation of available phosphorus in soils by extraction with sodium bicarbonate. US Department of Agriculture.

Piper CS (1966) Soil and plant analysis, Hans's publication Bombay, pp 368.

Parker FW, Nelson WL, Winters E, Miles IE (1951) The broad interpretation and application of soil test information. *Agron J* 43(3): 105-112.

Rajendiran S, Dotaniya ML, Coumar MV, Sinha NK, Singh VK, Kundu S, Tripathi AK, Srivastava S, Saha JK, Patra AK (2020) Block level soil fertility status of tribal dominated Jhabua District of Madhya Pradesh, India. *J Ind Soc Soil Sci* 68(1): 70-77.

Ramamoorthy B, Bajaj JC (1969) Nitrogen, phosphorus and potash status of Indian soils. *Fer News* 14: 25-28.

Sachin HE, Singh YV, Bindu KR, Sai Pavan D, Latare AM, Meena RN (2019) Soil quality assessment of different villages of Chikkamagalur block in Chikkamagalur district of

Karnataka (India). *J Pharmacog Phytochem* 8(2): 1918-1921.
Sachin HE, Singh YV, Bindu KR, Sai Pavan D, Meena RN (2021) Ground water quality assssment of different villages of Chikkamagalur block in Chikkamagalur district of Karnataka. *J Ind Soc Soil Sci* 69(2):142-146.
Schollenberger CJ, Simon RH (1945) Determination of exchange capacity and exchangeable bases in soil ammonium Acetate method. *Soil Sci* 59: 13- 24.
Sharma KL, Balaguruvaiah D, Babu MVS, Reddy BR, Rao CS, Mishra PK, Chary GR (2010) Long-term impact of soil and nutrient management practices on soil quality in rainfed Alfisols at Anantapur in Andhra Pradesh. *Ind J Dryland Agric Res Develop* 25(1): 74-85.
Sharma S, Singh YV, Saraswat A, Meena R, Khardia RN (2021) Soil quality assessment of different villages of Sanganer block in Jaipur district of Rajasthan (India). *Environ Ecol* 39 (4A): 1106—1113.
Sharma S, Singh YV, Saraswat A, Prajapat V, Kashiwar SR (2021) Ground water quality assessment of different villages of Sanganer block in Jaipur district of Rajasthan. *Ind J Agric Allied Sci* 7(3):52-56.
Singh YV (2018) Macro-nutrient status and their relationship with soil physico-chemical properties of Chandauli district of Uttar-Pradesh. *Technofame - A J Multidisciplinary Adv Res* 7(2): 13-16.
Singh YV (2019) Micro-nutrient status and their relationship with soil properties of Naugarh Tehsil, district Chandauli, Uttar Pradesh, India. *Technofame - A J Multidisciplinary Adv Res* 7(II): 13-16.
Singh YV, Ramana and Jat Lokesh Kumar (2015) Available micronutrient status, their relationship with soil properties of Raisinghnagar Tehsil, district Sri Ganganagar, Rajasthan, India. *J Rural Agric Res* 15(2): 21-24.
Singh NK, Singh YV, Barnwal PP (2021) Soil fertility status of Saidabad block of Prayagraj district, Uttar Pradesh. *Ind J Agric Allied Sci* 7(3):24-30.
Singh YV, Singh PK, Yadav RN, Sharma PK, Shahi SK, Singh Rajesh Kumar, Varma SK (2016) Evaluation of soil fertility status from Tedia Village, Araji line block, Varanasi district, Uttar Pradesh, India. *Ind J Agric Allied Sci* 1(2): 55-59.
Singh YV, Singh SK, Sharma PK, Meena R, Shahi SK (2017) Soil fertility status of village Dadhorpur, Arajiline block, district Varanasi, Uttar Pradesh, India. *Technofame - A J Multidisciplinary Adv Res* 6(1): 114-119.
Singh YV, Singh SK, Sahi Sanjay Kumar, Verma SK, Yadav RN, Singh PK (2016) Evaluation of soil fertility status from Milkipur village, Arajiline block, Varanasi, district, Uttar Pradesh, in relation to soil characteristics. *J Pure Appl Microbiol* 10(2): 1455-1461.
Singh YV, Kant Shashi, Singh SK, Sharma PK, Jat LK, Kumar M, Shahi SK, Jatav HS, Yadav RN (2017) Assessment of physico-chemical characteristics of the soil of Lahar block in Bhind district of Madhya Pradesh (India). *Int J Curr Microbiol Appl Sci* 6(2): 511-519.
Subbiah BV, Asija GL (1956) A rapid procedure for the determination of available nitrogen in soils. *Curr Sci* 25: 259-260.
Walkey AJ, Black CA (1934) An examination of the different method of determining soil organic matter and a proposed for modification of the chromic and titration method. *Soil Sci* 37(1): 29-38.