



ISSN: 0976-3031

Available Online at <http://www.recentscientific.com>

CODEN: IJRSFP (USA)

*International Journal of Recent Scientific Research*  
Vol. 13, Issue, 12 (A), pp. 2775-2779, December, 2022

**International Journal of  
Recent Scientific  
Research**

DOI: 10.24327/IJRSR

## Research Article

# ASSESSMENT OF CHEMICAL CHARACTERISTICS OF SOIL IN MANNACHANALLUR BLOCK OF TIRUCHIRAPALLI DISTRICT

Shifa.J<sup>1</sup>, S.Sowmiya<sup>2</sup>, R.R. Aswin prasanna<sup>3</sup>, S. Sridhar<sup>4</sup>, P. Nandhakumar<sup>5\*</sup>, S.Kumaravel<sup>6</sup> and A.T.Vigneshwarraj<sup>7</sup>

Nalanda College of Agriculture, Department of SS &AC, Trichirapalli, Tamil Nadu

DOI: <http://dx.doi.org/10.24327/ijrsr.2021.1312.0569>

### ARTICLE INFO

#### Article History:

Received 27<sup>th</sup> October, 2022

Received in revised form 24<sup>th</sup> November, 2022

Accepted 15<sup>th</sup> December, 2022

Published online 28<sup>th</sup> December, 2022

#### Keywords:

Soil testing, Macro nutrients, Micro nutrients, fertility status

### ABSTRACT

Soil is an indispensable resource for agriculture as it supplies essential nutrients for plant growth. Soil testing is one of the best available tools to characterize the properties of soil, thus enabling us to identify the soil's nutrient level. The present investigation of soil survey had been conducted during the May season of 2021-2022 in 44 villages of Mannachanallur block in Tiruchirapalli district which is located in Tamil Nadu, India, with the objective to assess the chemical characteristics of the soil. Forty four samples were collected in a grid manner which were dried in shade, powdered with wooden mallet, passed through 2 mm sieve which is then analyzed in the laboratory. The chemical properties such as pH, EC, OC were scrutinized. Macro nutrients which play a major role in the growth and development of the plant such as N, P, K and S and Micro nutrients such as Zn, Fe, Cu, Mn, and B were evaluated. The pH was observed to be moderately alkaline. The electrical conductivity was found in salt free condition. The Organic Carbon availability status was observed to be low. Nitrogen was noticed to be low to medium in status. Phosphorous was found to be low in availability. Potassium in the soil was found to be high along with medium sulphur content. Micro nutrients such as Copper was found to be high and Zinc, Ferrous, Manganese was accounted to be medium and Boron was valued to be low in condition. Utilizing such analytical work, it is feasible to know the fertility status and adopt accurate management practices that result in greater crop yield and sustainable agricultural production.

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### INTRODUCTION

Soil is the supreme resource for sustainable productivity and food security. Soil testing helps to determine the level of available nutrients in the soil of a given area and helps us to know the accurate fertilizer requirement or providing reclamation measures in case of problematic soil if identified. Tiruchirapalli is one of the districts in Tamil Nadu state. This district comprises of 14 blocks with total geographical area of 4403.83 Sq Km & lies between 10.7905° N and 78.7047° E. The study was taken over to characterize the chemical properties of soil in Mannachanallur which is one of the blocks located at 10.909133° N and 78.699455° E to establish the fertility status. The worldwide significant decline in soil productive capacity through physical, chemical, biological properties and contamination is by inorganic and organic chemicals. Fertilizer application based on soil tests is the best available approach for harvesting the economically viable potential yields of crops by increasing input use efficiency and maintaining soil health (Singh M. and Brar J.S. 2005). The deficiency may either be primarily due to their low contents or

secondarily by soil factors that reduce the availability (Sharma and Chaudhary, 2007). Soil health, biodiversity, and soil resilience are severely limited in extreme environments and are more sensitive to anthropogenic disturbance (Freckman and Virginia, 1997). Macronutrients had a remarkable impact on crop production, a dearth of micronutrients in the production system has caused excessive removal from the soil reserves that eventually led to deficiencies of micronutrients in soils. It has been reported that the occurrence of Zn, Fe, Cu, and Mn deficiencies was to an extent of 49%, 12%, 5%, and 3%, respectively, in India (Singh and Saha, 1995). Soil test-based fertility management is an effective tool for increasing productivity of agricultural soils that have high degree of spatial variability resulting from the combined effects of physical, chemical or biological processes (Goovaerts.P,1998).

However, major constraints impede wide scale adoption of soil testing in most developing countries. In India, these include the prevalence of small holding systems of farming as well as lack of infrastructural facilities for extensive soil testing (Sen, P, Majumdar, K. and Sulewski, G, 2008). However continuous

\*Corresponding author: P. Nandhakumar

Nalanda College of Agriculture, Department of SS &AC, Trichirapalli, Tamil Nadu.

cropping of high yielding varieties without proper substitution of inorganic fertilizers, non-addition of micronutrients, and less or no application of organic manures have caused excessive removal of essential nutrients from the soil reserves that eventually led to the deficiencies of micronutrients in soils. The deficiency may either be primarily due to their low contents or secondarily by soil factor that reduce the availability (Sharma and Chaudhary, 2007)

## MATERIALS AND METHODS

Geo coordinates of the sampled areas in Mannachanallur block was noted using geographical positioning system. Field wise surface soil samples from 44 villages were taken using grid survey and were analyzed for physical properties and chemical properties. Selected 44 surface soil samples (0-30cm) were collected in cloth bags as per the standard procedure recommended by United States Department of Agricultural Science. Quartering technique was used for preparation of soil samples. The samples were dried in air and passed through 2 mm sieve. The processed soil samples were analysed for their chemical characteristics as per the standard procedures. Soil pH was determined using digital pH meter. The Electrical conductivity with conduct metric method. OC by chromic acid wet digestion method. Available N, P, K and S by Alkaline permanganate method, Colorimetric method, Flame photometer method respectively. Micronutrients such as Zn, Cu, Fe, Mn, B were analyzed using Atomic Absorption Spectroscopy.

**Table 1** Analytical Methods for soil analysis

S. No.	Properties	Methodology	Author
<b>I. Physico-chemical properties</b>			
1.	Soil reaction (pH)	Potentiometric method (1:2.5 soil: water extract)	Jackson (1973)
2.	Electrical conductivity (EC)	Conductometric method (1:2.5 soil: water extract)	Jackson (1973)
<b>II. Chemical properties</b>			
3.	Organic carbon (OC)	Chromic acid wet digestion method	Walkely and Black (1934)
4.	Available nitrogen (KMnO <sub>4</sub> -N)	Alkaline permanganate method	Subbiah and Asija (1956)
5.	Available phosphorus (Olsen-p)	Colorimetric method	Olsen <i>et al.</i> , (1954)
6.	Available potassium (NH <sub>4</sub> OAc-K)	Flame photometer method	Stanford and English (1949)
<b>III. Exchangeable cations (cmol (p<sup>+</sup>)kg<sup>-1</sup>)</b>			
7.	Available micronutrients (Zn, Fe, Mn and Cu)	DTPA extract – Atomic Absorption Spectrophotometer method(AAS)	Lindsay and Norvell (1978)
8.	Available boron	Azomethine – H method	Wolf (1974)

## RESULTS AND DISCUSSION

### Soil pH

The pH of the surface soils in different villages of Manachanallur block in Tiruchirappalli district varied widely with overall mean value of 8.41. However, majority of blocks were found to be alkaline. Out of 44 villages the lowest mean pH value is 7.7 which is observed in Pichandavar kovil and the highest mean pH value is 9.49 which is observed in S Kannanur (W) respectively. Hence, pH estimation of the soil samples was observed and came to the result that it was moderately alkaline in reaction.

### Electrical Conductivity

The mean value of electrical conductivity in the surface soils of Manachanallur block is 0.45 dS m<sup>-1</sup>. Out of 44 villages lowest mean EC of 0.14 dS m<sup>-1</sup> and the highest mean EC of 1 dS m<sup>-1</sup> was recorded in Vaaliyur and Sanamangalam respectively. EC estimation of the soil sample was observed and came to the result that it was salt free in nature.

### Organic Carbon

The organic carbon content of surface soils in in different villages of Manachanallur block in Tiruchirappalli district ranged from 0.3 to 0.42 percent. Based on low (< 0.50%), medium (0.50 – 0.75%) and high (> 0.75%) status, all villages fall under low levels of organic carbon with an overall mean value of 0.37%. Therefore the result show that organic carbon of soil samples is of low range based on table 2.

### Macronutrients

#### Available Nitrogen

The N content of the surface soils in different villages of Manachanallur block in Tiruchirappalli district varied widely with overall mean value of 172.74 kg/ha. Out of 44 villages the lowest mean N content is found to be 14.8 kg/ha in kariyamanikam(E) and the highest mean N content is found to be 193.50 kg/ha in Thirupattur, Edumalai, Kariyamanickam (W), Sridevimangalam (N), Palaiyur, Siruganur, Vaazhaiyur, Kalpalayam, Sanamangalam, Solanganallur, Avaravalli, Perakambi, Sirupattur, Sridevimangalam (S), Vaaliyur. Considering table 3 the soil test rating for available N (<250 kgmha as low, 250-500kgmha as medium and >500kg/ha as high in the status of N), the soil sample were found as low to medium available N content. In this way, almost all the soil samples tested for available N were found to be deficient in N.

#### Available Phosphorous

The P content of the surface soils in different villages of Manachanallur block in Trichirappalli district varied widely with overall mean value of 19.11 kh/ha. Out of 44 villages the lowest mean P content is found to be 10.23 kg/ha in Rasampalayam and Ayyampalyam and the highest mean P content is found to be 43.18 kg/ha in Ayaikudi. Considering table 3 the soil test rating for available phosphorus (0-10 kg/ha as very low, 11-20 kg/ha as low, 21-40 kg/ha as medium and > 40 kg/ha as high) .Majority of the soil samples were observed under very low to low status in available phosphorus

#### Available Potassium

The K content of the surface soils in different villages of Manachanallur block in Trichirappalli district varied widely with overall mean value of 485.78 kg/ha. Out of 44 villages the

lowest mean P content is found to be 288.9 kg/ha in Poonampalayam and the highest mean P content is found to be 605.23 kg/ha in Thirupattur, Edumalai, Kariyamanickam(W), Sridevimangalam(N), Palaiyur, Sirganur, Vaazhayur, Kalpalayam, Sanamangalam, Melpathu, Solanganallur, Avaravalli, Perakambi, Sirupattur, Sridevimangalam(S),

Vaaliyur. Considering table 3 the soils having 0-50 kg ha<sup>-1</sup> as very low, 51-100 kg ha<sup>-1</sup> as low, 101-250 kg/ha as medium and >250 kg/ha as high in available potassium contents. soil samples were observed to be high status in available potassium.

**Table 2** Physical characteristics of the block

Sample no.	Village Name	pH	EC (dS m <sup>-1</sup> )	OC (%)	N (kg/ha)	P (kg/ha)	K (kg/ha)	S (ppm)
1	Kuthoor	8.47	0.30	0.37	171.90	30.42	316.71	12.32
2	Melasridevimangalam	8.30	0.21	0.35	173.30	17.41	367.69	12.66
3	Kiliyanallur (S)	8.00	0.97	0.40	156.60	26.60	300.70	12.79
4	Thirupanchili(N)	8.48	0.98	0.35	152.59	15.71	390.08	12.74
5	Thiruvellarai	8.17	0.22	0.37	155.90	17.08	449.08	12.72
6	Kariyamanickam(E)	8.50	0.47	0.38	14.80	30.31	407.61	11.73
7	Thirampalayam	8.32	0.15	0.37	155.90	17.08	449.08	12.72
8	Thiruvasi	8.00	0.47	0.37	171.10	15.25	496.00	12.71
9	Thirupanchili(S)	8.31	0.90	0.39	175.90	17.35	363.90	12.73
10	Omanthur	8.50	0.34	0.37	155.90	17.08	449.08	12.72
11	Rasampalyam	8.24	0.21	0.36	189.80	10.23	371.38	12.69
12	Thirupattur	8.30	0.53	0.38	193.50	14.15	605.23	12.75
13	Alagiyamanavalan	8.47	0.34	0.42	160.60	21.35	570.54	12.71
14	Pichandavarkovi	7.70	0.41	0.36	159.30	34.25	289.00	12.69
15	Ethumalai	8.46	0.65	0.38	193.50	14.15	605.23	12.75
16	Kariyamanickam(W)	8.50	0.16	0.38	193.50	14.15	605.23	12.75
17	Sirugudi	8.83	0.27	0.40	155.20	12.46	452.23	12.71
18	Sridevimangalam(N)	8.70	0.25	0.38	193.50	14.15	605.23	12.75
19	Konalai	8.40	0.40	0.42	160.60	21.91	570.54	12.71
20	Palaiyur	8.48	0.21	0.38	193.50	14.15	605.23	12.75
21	Siruganur	8.48	0.82	0.38	193.50	14.15	605.23	12.75
22	Vazhaiyur	8.45	0.46	0.38	193.50	14.15	605.23	12.75
23	Ulunthangudi	8.40	0.29	0.37	171.10	22.87	496.31	12.71
24	Kalpalayam	8.47	0.26	0.38	193.50	14.15	605.23	12.75
25	Vengangudi	8.50	0.56	0.38	159.30	26.22	288.92	12.69
26	Melpathu	8.20	0.50	0.38	193.40	14.14	605.23	12.08
27	Ayyampalayam	8.13	0.25	0.34	177.00	10.23	409.60	12.68
28	Kavathakudi	8.40	0.47	0.33	187.30	11.75	473.23	12.72
29	Thathamangalam	8.40	0.19	0.33	179.50	15.77	435.54	11.76
30	Madhavarperumalkvil	8.17	0.21	0.39	175.19	29.91	363.92	12.73
31	S Kannanur(W)	9.49	0.34	0.37	166.80	31.83	597.30	13.32
32	Samayapuram	8.27	0.45	0.33	144.90	18.77	325.92	12.67
33	Manachanallur	8.49	0.54	0.30	177.60	31.00	589.58	4.86
34	No10Kariyamanickam	8.50	0.36	0.38	176.00	17.08	457.00	11.96
35	Poonampalayam	8.50	0.46	0.40	159.30	19.45	288.90	12.70
36	S Kannanur(E)	8.48	0.40	0.39	168.50	31.83	330.85	13.32
37	Sanamangalam	8.40	1.00	0.38	193.50	14.15	605.23	12.75
38	Solanganallur	8.80	0.23	0.38	193.50	14.15	605.23	12.75
39	Avaravalli	8.40	0.73	0.38	193.50	14.15	605.23	12.75
40	Perakambi	8.48	0.64	0.38	193.50	14.15	605.23	12.75
41	Ayaikudi	8.49	0.89	0.35	152.90	43.18	390.08	12.74
42	Sirupathur	8.50	0.97	0.38	193.50	14.15	605.23	12.75
43	Sridevimangalam(S)	8.40	0.36	0.38	193.50	14.15	605.23	12.75
44	Vaaliyur	8.42	0.14	0.38	193.50	14.15	605.23	12.75
	Mean Value	8.41	0.40	0.37	172.74	19.11	485.78	12.49

#### Available Sulphur

The available sulphur in ranged from 4.86-13.32 ppm with a mean of 12.49 ppm, which falls under high category. Among all the villages the lowest mean value of available sulphur of 4.86 ppm was recorded in Manachanallur while the highest available sulphur 13.32 ppm in S Kananur(E) and S Kananur(W). Considering table 3 the soils having < 10 ppm as low, 10-15.6 ppm as medium and >15.6 ppm as high in

available sulphur contents. Soil samples were observed to be medium status in available sulphur.

#### Micronutrients

##### Available Zinc

The DTPA-Zn content of soils ranged from 0.59 to 2.06 ppm with mean value of 0.92 ppm. The soils of Ayaikudi with value of 2.06 ppm recorded the highest mean value for DTPA-Zn and lowest mean value recorded in soil of Kariyamanickam (E)

with value of 0.59 ppm. Considering table 4 the soils having < 0.6 ppm as low, 0.6-1.2 ppm as medium and >1.2

ppm as high in available zinc contents. Soil samples were observed to be medium status in available zinc.

**Table 2** Micronutrients availability in the block

Sample no	Village Name	Zn (ppm)	Fe (ppm)	Cu (ppm)	Mn (ppm)	B (ppm)
1	Kuthoor	0.77	5.78	1.19	2.48	0.22
2	Melasridevimangalam	0.92	5.60	0.92	5.35	0.20
3	Kiliyanallur (S)	0.83	5.18	0.13	2.66	0.23
4	Thirupanchili(N)	0.94	5.13	0.94	3.77	0.23
5	Thiruvellarai	0.83	4.86	0.94	3.39	0.25
6	Kariyamanikam(E)	0.59	4.72	0.60	3.35	0.20
7	Thirampalayam	0.83	4.86	0.94	3.39	0.25
8	Thiruvasi	0.83	5.35	0.87	3.56	0.21
9	Thirupanchili(S)	0.89	6.43	1.02	3.40	0.22
10	Omanthur	0.83	4.86	0.94	3.39	0.25
11	Rasampalayam	0.67	6.23	0.87	3.31	0.21
12	Thirupattur	0.91	4.92	0.95	4.15	0.29
13	Alagiyamanavalan	0.88	4.95	0.90	2.87	0.22
14	Pichandavarkovi	0.68	6.46	1.15	2.51	0.25
15	Ethumalai	0.91	4.92	0.95	4.15	0.29
16	Kariyamanikam(W)	0.91	4.92	0.95	4.15	0.29
17	Sirugudi	1.80	5.23	0.93	3.29	0.24
18	Sridevimangalam(N)	0.91	4.92	0.95	4.15	0.29
19	Konalai	0.88	4.95	0.90	2.87	0.22
20	Palaiyur	0.91	4.92	0.95	4.15	0.29
21	Siruganur	0.91	4.92	0.95	4.15	0.29
22	Vazhaiyur	0.91	4.92	0.95	4.16	0.29
23	Ulunthangudi	0.83	5.35	0.87	3.58	0.21
24	Kalpalayam	0.91	4.92	0.95	4.15	0.29
25	Vengangudi	0.68	6.46	1.15	2.51	0.23
26	Melpathu	0.91	4.92	0.95	4.15	0.29
27	Ayyampalayam	0.96	6.35	1.10	3.83	0.25
28	Kavathakudi	0.94	3.76	0.89	3.27	0.27
29	Thathamangalam	0.95	5.19	0.87	2.89	0.23
30	Madhavarperumalkvil	0.91	5.13	0.91	2.65	0.22
31	S Kannanur(W)	1.40	2.58	0.87	3.24	0.23
32	Samayapuram	0.72	5.17	0.88	3.30	0.20
33	Manachanallur	1.00	3.01	0.96	11.8	0.22
34	No10Kariyamanikam	0.99	6.42	0.91	3.00	0.23
35	Poonampalayam	0.70	6.50	1.10	2.50	0.20
36	S Kannanur(E)	0.76	4.92	1.06	3.61	0.22
37	Sanamangalam	0.91	4.92	0.95	4.15	0.29
38	Solanganallur	0.91	4.92	0.95	4.15	0.29
39	Avaravalli	0.91	4.92	0.95	4.15	0.29
40	Perakambi	0.91	4.92	0.95	4.15	0.29
41	Ayaikudi	2.06	8.04	1.15	5.10	0.23
42	Sirupathur	0.91	4.92	0.95	4.15	0.29
43	Sridevimangalam(S)	0.91	4.92	0.95	4.15	0.29
44	Vaaliyur	0.91	4.92	0.95	4.15	0.29
	<b>Mean Value</b>	<b>0.92</b>	<b>5.19</b>	<b>0.94</b>	<b>3.80</b>	<b>0.25</b>

**Available Iron**

The Fe content of soils ranged from 2.58 to 8.04 ppm with mean value of 5.19 ppm. The soils of S Kannanur(W) with value of 2.58 ppm recorded the lowest mean value for Fe and highestt mean value recorded in soil of Ayaikudi with value of 8.04 ppm. Considering table 4 the soils having < 4.5 ppm as low, 4.5-9.0 ppm as medium and >9.0 ppm as high in available iron contents. Soil samples were observed to be medium status in available iron.

**Available Copper**

The content of DTPA-Cu in the soils of ranged from 0.13 to 1.19 ppm with mean value of 0.94 ppm.The highest mean value of 1.19was recorded in soils of Kuthoor and the lowest mean

value was recorded 0.13 ppm in Kiliyanallur. Considering table 4 the soils having < 0.2 ppm as low, 0.2-0.4 ppm as medium and >0.4 ppm as high in available copper contents. Soil samples were observed to be high status in available copper.

**Available Manganese**

The content of Mn in the soils of ranged from 2.48 to 11.8 ppm with mean value of 3.80 ppm. The highest mean value of 11.8 ppmwas recorded in soils of Manaachanallur and the lowest mean value was recorded 2.48 ppm in Koothur. Considering table 4 the soils having < 3.5 ppm as low, 3.5-7.0 ppm as medium and >7.0 ppm as high in available manganese contents. Soil samples were observed to be medium status in available manganese.

### **Available Boron**

The content of B in the soils of ranged from 0.20 to 0.29 ppm with mean value of 0.25 ppm. The highest mean value of 0.29 was recorded in soils of Thirupattur, Edumalai, Kariyamanikam(W), Sridevimangalam (N), Palaiyur, Siruganur, Vazhaiyur, Kalpalayam, Melpathu, Sanamangalam, Solanganallur, Avaravalli, Perakambi, Sirupattur, Sridevimangalam (S), Vaaliyur and the lowest mean value was recorded 0.2 ppm in Melasridevimangalam. . Considering table 4 the soils having < 0.5 ppm as low, 0.5-1.0 ppm as medium and >1.0 ppm as high in available boron contents. Soil samples were observed to be low status in available boron.

### **CONCLUSION**

The study of chemical parameters of soil samples from different villages in Manachanallur block, Trichy district, revealed that they ranged from moderately alkaline. The electrical conductivity was found to be in salt free condition. The organic carbon availability status was observed to be low. Soil samples from that area revealed deficiencies in available N, very low to low P content, a high level of K content, and a medium level of sulphur. Micronutrient levels are high for available copper, medium for available zinc, manganese, and iron, and low for available boron.

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