E-ISSN: 2618-0618
P-ISSN: 2618-060X

NAAS Rating (2025): 5.20
www.agronomyjournals.com
2025; SP-8(8): 272-276
Received: 19-05-2025
Accepted: 23-06-2025

P Devi Shravani
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Rajendranagar, Professor Jayashankar Telangana Agricultural University, Hyderabad, Telangana, India

G Kiran Reddy
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Rajendranagar, Professor Jayashankar Telangana Agricultural University, Hyderabad, Telangana, India

M Ramprasad
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Rajendranagar, Professor Jayashankar Telangana Agricultural University, Hyderabad, Telangana, India

K Indudhar Reddy
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Rajendranagar, Professor Jayashankar Telangana Agricultural University, Hyderabad, Telangana, India

Corresponding Author:
P Devi Shravani
Department of Soil Science and Agricultural Chemistry, College of Agriculture, Rajendranagar, Professor Jayashankar Telangana Agricultural University, Hyderabad, Telangana, India

Assessment of physico-chemical and chemical properties of soils under turmeric growing sites of Nizamabad District, Telangana

P Devi Shravani, G Kiran Reddy, M Ramprasad and K Indudhar Reddy

DOI: https://www.doi.org/10.33545/2618060X.2025.v8.i8Sd.3551

Abstract
A detailed soil survey was conducted in major turmeric growing soils of Nizamabad district Telangana state to examine the physico-chemical and chemical properties of soils. Soil samples (40 surface and 40 subsurface) were collected at a depth of 0-15cm and 15-30cm. Collected soil samples were analyzed for their physico-chemical properties (pH, EC, and OC) as well as chemical properties, including available nitrogen (N), phosphorus (P), and potassium (K). The pH of the soil was slightly acidic to slightly alkaline (6.2 – 8.6) in nature and the EC was non saline (0.08 – 0.54 dS m-1) suitable for all crops. Organic carbon was found low to medium (3.60 to 8.50 g kg-1), these soils had low to medium nitrogen levels (101.20 – 389.50 kg ha-1) Phosphorus (14.69 – 69.97 kg ha-1) and potassium (114.80 – 356.80 kg ha-1) were found low to high in ranges.

Keywords: Turmeric, Nizambad, soil depth, surface, subsurface, physico-chemical and chemical properties.

1. Introduction
Turmeric is one of the major commercial crop which is grown around 9284 ha (Turmeric outlook, April 2025) in Nizamabad district, Telangana. The current status of soil nutrients presents a complex and pressing challenge in global agriculture**.** Imbalances in soil nutrient levels ranging from severe depletion in some regions to excessive accumulation in others are threatening long-term soil fertility, crop yields, and environmental sustainability (FAO, 2021) [3]. As turmeric is grown in vast area in Nizamabad district there is a need to study the nutrient status of the soils under this crop. However, vital macronutrients are necessary for crop growth, phosphorus for increasing the oil content, indicating its influence on both yield and quality parameters and potassium enhances rhizome yield, curcumin content, and dry matter accumulation in turmeric (Singh *et al.*, 2010) [16]. It is already known that the nutritional properties of soil are the basic attributes that influence the growth, development, and productivity of crops by directly affecting nutrient availability, root health, and overall soil fertility. Hence, the present study was taken up in the major turmeric growing soils of Nizamabad district with an objective to assess the physico-chemical and chemical properties of the soils.

2. Materials and Methods
Location and site characteristic of study area
The study area was Nizamabad district. It is situated between 18°04'4.8" and 19°00'54" of Northern Latitude and 77°31'41" and 78°40'1.2" of Eastern Longitude. Nizamabad district is surrounded by Nirmal district to the north, Nanded district (of Maharashtra) to the west, Jagtial and Rajanna Sircilla districts to the east, and Kamareddy district to the south and east. The district comes under semi-arid climate which receives an average rainfall of 1108 mm. The district experiences an average maximum temperature of 39.9◦C and minimum temperature of 13.7◦C with annual max. relative humidity varying from 82.71% max and min. of 50%. In order to delineate the detailed field wise physico-chemical and macronutrient nutrients status in the

surface and subsurface soils, 40 surface (0-15 cm) and 40 sub-surface (15-30 cm) soil samples were collected from Jakranpalle, Armoor, Balkonda, Mupkal, Velpur, Navipet, Dharpalle, Nandipet, Morthad, Makloor, Madnoor, Kammarpally and Srikonda mandals by using the quarter technique. The composite soil samples were packed and labelled properly in polythene bags and brought to the laboratory for further analysis.

Methods used for analysis

The collected soil samples were analysed for pH, EC and available N, P, K. pH and EC was estimated by the method using 1:2 soil water suspension (Jackson *et al*. 1973) [6]. Organic carbon was estimated by using Walkley and Black (1934) [19] rapid titration method. Available nitrogen was determined by using alkaline potassium permanganate method as given by Subbaiah and Asija (1956) [17]. Available Phosphorus was estimated by Olsen's extraction followed by Spectrophotometric method, available Potassium was estimated by Neutral normal Ammonium Acetate extraction followed by Flame photometric method. The data were statistically analysed using SPSS.

Fig 1: Location identification map of Nizamabad district

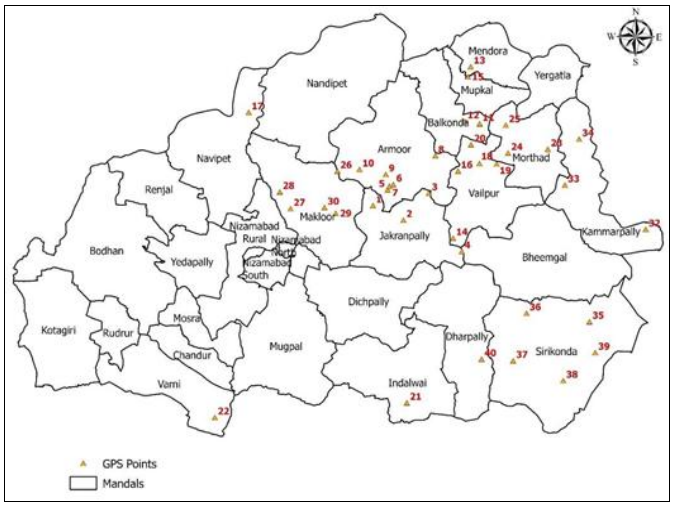

Fig 2: Sampling identification map

Results and Discussion

Physico-chemical properties

The pH (Table 1) of surface soils (0-15 cm) and sub-surface soils (15-30cm) ranged from 6.2 to 8.3 and 6.9 to 8.6 respectively, with the mean values of 7.5 and 8.1 respectively, indicating slightly acidic to slightly alkaline in nature. The lowest surface pH was recorded in Manal with pH 6.2 and highest surface pH 8.3 was recorded in Anksapoor. The lowest subsurface pH (6.9) was recorded in (Munipalle) and highest (8.6) was recorded in Chintalur. This shows that pH increases with increasing depth. The lower pH in surface samples was mainly attributed to the leaching of bases (Vasundhara *et al*., 2022) [18]. The EC (Table 1) of surface and subsurface soils ranged from 0.08 to 0.46 dS m-1 and 0.12 to 0.54 dS m-1 respectively, with the mean 0.31 and 0.40 dS m-1. The lowest surface value of EC (0.08 dS-1) was recorded in Munipalle and the highest EC (0.46 dS m-1) was recorded in Armoor. The lowest subsurface EC (0.12 dS m-1) was recorded in Munipalle and highest (0.54 dS m-1) was recorded in Siddapur. indicating all soils are non-saline in nature and increase in EC with increase in depth likely due to wash away of salts possibly due to light texture Arya *et al.* (2024) [1].

Organic carbon

Organic carbon (Table 1) of surface and subsurface ranged from 4.80 to 8.50 and 3.60 to 7.83 g kg -1 respectively, with the mean values of 6.65 and 5.62 g kg-1 respectively. The lowest organic carbon (4.80 g kg-1) of surface soils was found in Sirnapally and highest (8.50) was found in Kothapalle. The lowest organic carbon in subsurface (3.60 g kg-1) was found in Sirnapally and highest (7.83 g kg-1) was recorded in Chinawalgot. All the soils were in the range of low to high in soil organic carbon (Malavath *et al*. 2019) [7]. This shows that there was a decrease in trend of OC with depth. This decline was likely due to higher inputs of decomposable organic material in surface compared to subsurface (Dinsa and Elias 2021) [2].

Macronutrients

Available nitrogen (Table 2) in surface and subsurface was in the range of 143.10 to 389.50 kg ha-1 and 101.20 to 297.50 kg ha-1, with the mean values of 220.94 and 179.16 kg ha-1 respectively. Available nitrogen was low to medium in range. Surface soil of Kothapalle had highest value of 389.50 kg ha-1, while Sirnapally had lowest value (143.10 kg ha-1). Subsurface soil of Chintalur was recorded lowest (101.20 kg ha-1) and highest (297 kg ha-1) in Basheerabad. The low nitrogen content in the soil may attributed to perivious soil management practices and the inconsistent application of farymyard manure and fertilizers. Nitrogen is often the most limiting nutrient in soils due to its susceptibility to losses through fixation and volatilization. Additionally low organic matter content and elevated temperatures can accelerate the decomposition and loss of organic material, further exacerbating nitrogen deficiency. Similar results were reported by Reddy *et al*. (2021) [15] and Gurudev *et al*. (2024) [5]. The available P2O5 content (Table 2) of soils was low to high and varied from 19.74 to 69.97 kg ha-1 in surface samples and was varied from 14.69 to 60.11 kg ha-1 in the sub surface soils. With the mean values of 47.41 kg ha-1 in surface to 39.95 kg ha-1 in subsurface. In majority of the surface soil the available P2O5 was medium. Sirnapally has the lowest surface value of 19.74 kg ha-1 while Basheerabad has the highest value of 69.97 kg ha-1. Lowest subsurface value (14.69 kg ha-1) was found in Sirnapally and highest (60.11 kg ha-1) was found in Basheerabad. The lower phosphorus content in sub-surface which means decline in P2O5 with depth (Gowthamchand *et al*., 2023) [4] was caused by its fixation by clay minerals and iron and aluminum oxides (Gurudev *et al*., 2024) [5]. The semi-arid environment, combined with the continuous use of high-analysis fertilizers—particularly DAP—without considering crop requirements and existing soil nutrient

levels, has led to a buildup of phosphorus. This has contributed to the observed medium to high levels of available phosphorus in the soils of the study area (Kiran *et al*. 2021). The availability of K2O (Table 2) in soils ranged from low to high and varied from 132.30 to 356.80 kg ha-1- in surface soils and 114.80 to 326.60 kg ha-1 in sub surface soils with the mean values of 228.58 to
197.74 kg ha-1 respectively. Majority of soils were medium in available K2O. The lowest surface value (132.30 kg ha-1) was recorded in Munipalle, while the highest (356.80 kg ha-1) was recorded in Chinawalgot. The lowest subsurface value (114.80 kg ha-1) was found in Brahmanapalle and highest (326.60 kg ha-1) was found in Dammannapet. Available potassium generally decreased with depth, possibly due to potassic fertilizers. The results are in conformity with Pattnaik *et al*. (2025) [10] and Poojitha *et al*. (2024) [11]. More intensive weathering, release of labile-K from organic residues of cultivated crop plants and upward translocation of K from lower depths along with capillary rise of ground water. Similar results were reported by Pal and Mukhopadyay (1992) [12].

Table 1: Phyciso-chemical properties and organic carbon

SL. No.	Latitude	Longitude	Mandal	Village	pH		EC dS m-1		OC g kg-1	
					0 - 15 cm	15 - 30 cm	0 - 15 cm	15 - 30 cm	0 - 15 cm	15 - 30 cm
1	18.7526	78.234424	Jakranpalle	Munipalle	6.3	6.9	0.08	0.12	4.94	3.63
2	18.7325	78.276992	Jakranpalle	Argul	7.6	8.2	0.12	0.27	6.76	5.24
3	18.7694	78.312709	Jakranpalle	Brahmanpalle	7.9	8.3	0.45	0.51	5.70	4.25
4	18.6893	78.358764	Jakranpalle	Chintalur	8.1	8.6	0.36	0.43	4.99	3.68
5	18.7741	78.254882	Jakranpalle	Laxmapoor	7.4	8.1	0.28	0.35	6.97	5.43
6	18.7815	78.26282	Armoor	Armoor	7.0	7.9	0.46	0.50	6.26	5.80
7	18.7793	78.257257	Armoor	Ankapur	7.5	8.3	0.32	0.47	7.94	6.37
8	18.8212	78.321837	Armoor	Chepur	7.9	8.5	0.45	0.49	7.87	6.44
9	18.7953	78.25237	Armoor	Issapalle	7.7	8.4	0.28	0.37	6.89	5.22
10	18.8023	78.215567	Armoor	Alur	6.8	7.5	0.16	0.27	6.53	5.11
11	18.8651	78.383839	Balkonda	Vannel b	7.9	8.2	0.08	0.24	4.93	4.31
12	18.8684	78.362683	Balkonda	Bodepalle	7.7	8.3	0.32	0.40	8.26	7.60
13	18.9438	78.371402	Balkonda	Bussapur	7.9	8.2	0.17	0.26	7.64	6.86
14	18.7076	78.346722	Balkonda	Kothapalle	7.6	8.3	0.25	0.39	8.50	7.36
15	18.9298	78.367337	Mupkal	Nallur	8.1	8.4	0.14	0.29	5.29	4.72
16	18.8	78.353654	Velpur	Lakhora	7.8	8.0	0.30	0.41	5.65	4.91
17	18.8809	78.060243	Navipet	Binola	7.8	8.5	0.28	0.39	6.63	5.50
18	18.8104	78.383654	Velpur	Anksapoor	8.3	8.5	0.20	0.27	7.78	6.48
19	18.8096	78.407681	Velpur	Kuknoor	8.0	8.4	0.32	0.40	7.20	6.95
20	18.8364	78.371855	Velpur	Padgal	6.8	8.5	0.19	0.38	7.79	6.30
21	18.4809	78.282009	Dharpalle	Sirnapally	6.7	7.3	0.35	0.43	4.80	3.60
22	18.4606	78.012788	Nandipet	Siddapur	7.6	7.8	0.42	0.54	6.50	5.72
23	18.8301	78.479382	Morthad	Vaddiyat	7.5	8.0	0.37	0.42	5.16	4.62
24	18.8248	78.423761	Morthad	Donkal	7.9	8.4	0.39	0.48	6.14	5.88
25	18.8631	78.420625	Morthad	Darmora	7.5	7.9	0.45	0.51	6.69	5.39
26	18.7998	78.184485	Makloor	Kalladi	6.8	7.3	0.38	0.43	5.56	4.34
27	18.748	78.118981	Makloor	Mamidipally	7.4	8.2	0.43	0.51	6.31	5.71
28	1.9E+07	78.103834	Makloor	Mullangi	7.6	7.9	0.39	0.48	7.49	6.88
29	18.7418	78.182169	Makloor	Chinnapur	7.2	7.5	0.44	0.50	5.61	4.79
30	18.7497	78.166499	Makloor	Singampalle	7.3	7.8	0.41	0.49	8.27	6.90
31	18.4646	77.576074	Madnoor	Chinnathadgur	7.6	8.3	0.26	0.32	5.52	4.95
32	18.7196	78.616543	Kammarpally	Konapur	7.8	8.4	0.35	0.42	7.78	6.69
33	18.7808	78.503317	Kammarpally	Basheerabad	7.7	8.2	0.25	0.36	8.36	7.49
34	18.8439	78.523329	Kammarpally	Dammannapet	7.5	8.4	0.40	0.51	8.27	7.59
35	18.6248	78.625961	Sirikonda	Sirikonda	6.2	7.3	0.27	0.34	6.60	5.86
36	18.6042	78.449527	Sirikonda	Chinawalgot	7.8	8.3	0.36	0.43	8.28	7.83
37	18.5387	78.430895	Sirikonda	Gadkole	6.7	7.7	0.29	0.37	5.86	4.63
38	18.5113	78.501071	Sirikonda	Pakala	7.8	8.3	0.25	0.36	6.50	5.24
39	18.55	78.545862	Sirikonda	Chimanpalle	7.4	8.2	0.39	0.45	5.75	4.34
40	18.5409	78.386655	Sirikonda	Honnajipet	7.4	8.3	0.34	0.43	5.83	4.25
				MIN	6.2	6.9	0.08	0.12	4.80	3.60
				MAX	8.3	8.6	0.46	0.54	8.50	7.83
				Mean	7.5	8.1	0.31	0.40	6.65	5.62
				SD	0.5	0.4	0.11	0.09	1.14	1.19

Table 2: Available Nitrogen, Phosphorus, Potassium

SL. No.	Latitude	Longitude	Mandal	Village	N kg ha^{-1}		P2O5 kg ha^{-1}		K2O kg ha^{-1}	
					0–15 cm	15-30 cm	0–15 cm	15-30 cm	0–15 cm	15-30 cm
1	18.752559	78.234424	Jakranpalle	Munipalle	150.00	113.70	30.35	26.80	132.30	114.80
2	18.732461	78.276992	Jakranpalle	Argul	218.90	193.20	46.40	41.43	191.50	164.60
3	18.769402	78.312709	Jakranpalle	Brahmanpalle	175.20	128.60	45.64	37.60	156.80	144.10
4	18.689279	78.358764	Jakranpalle	Chintalur	155.50	101.20	20.69	17.34	144.10	123.00
5	18.7740516	78.254882	Jakranpalle	Laxmapoor	228.70	199.10	48.37	41.98	182.20	144.20
6	18.781484	78.262820	Armoor	Armoor	180.90	139.70	46.62	39.31	190.90	174.60
7	18.779329	78.257257	Armoor	Ankapur	271.00	211.90	53.58	46.07	296.90	202.30
8	18.821199	78.321837	Armoor	Chepur	255.20	212.30	52.70	46.49	282.40	239.70
9	18.795314	78.25237	Armoor	Issapalle	226.50	198.60	49.98	37.46	189.30	160.10
10	18.802267	78.215567	Armoor	Alur	195.20	152.30	48.94	36.05	275.60	203.10
11	18.865099	78.383839	Balkonda	Vannel b	152.20	103.40	49.20	28.85	235.20	162.00
12	18.868433	78.362683	Balkonda	Bodepalle	339.10	264.90	53.35	49.21	349.40	323.00
13	18.943820	78.371402	Balkonda	Bussapur	268.00	211.20	54.62	46.78	284.00	256.80
14	18.707561	78.346722	Balkonda	Kothapalle	389.50	292.00	67.88	58.40	354.20	315.50
15	18.929839	78.367337	Mupkal	Nallur	156.40	115.30	44.11	36.50	253.30	175.70
16	18.800029	78.353654	Velpur	Lakhora	169.80	122.70	43.31	39.68	184.80	160.90
17	18.880908	78.060243	Navipet	Binola	201.20	182.30	48.96	39.71	199.10	169.20
18	18.810398	78.383654	Velpur	Anksapoor	253.70	217.50	53.93	45.88	287.50	252.80
19	18.809619	78.407681	Velpur	Kuknoor	232.40	192.70	52.48	44.03	267.40	248.20
20	18.836425	78.371855	Velpur	Padgal	246.40	209.70	54.83	44.46	238.40	209.70
21	18.480914	78.282009	Dharpalle	Sirnapally	143.10	103.40	19.74	14.69	160.40	142.60
22	18.460624	78.012788	Nandipet	Siddapur	191.60	150.10	48.29	41.89	175.90	150.40
23	18.830087	78.479382	Morthad	Vaddiyat	154.60	121.20	42.07	34.45	180.40	167.50
24	18.824795	78.423761	Morthad	Donkal	179.80	146.70	47.34	39.14	171.50	156.80
25	18.86312	78.420625	Morthad	Darmora	206.40	178.20	46.92	40.91	178.00	154.00
26	18.799838	78.184485	Makloor	Kalladi	160.10	147.10	43.31	40.70	160.70	145.10
27	18.748038	78.118981	Makloor	Mamidipally	184.70	138.60	46.34	38.71	178.20	150.10
28	18771274	78.103834	Makloor	Mullangi	232.70	204.10	51.63	42.34	287.20	269.90
29	18.741751	78.182169	Makloor	Chinnapur	163.60	147.10	42.40	38.54	188.90	156.10
30	18.749729	78.166499	Makloor	Singampalle	347.70	289.70	56.70	49.26	322.60	295.30
31	18.464634	77.576074	Madnoor	Chinnathadgur	158.80	130.80	41.55	36.47	183.90	161.60
32	18.719563	78.616543	Kammarpally	Konapur	248.60	207.10	52.19	43.68	279.40	220.70
33	18.780786	78.503317	Kammarpally	Basheerabad	387.20	297.50	69.97	60.11	350.40	326.10
34	18.843869	78.523329	Kammarpally	Dammannapet	352.90	280.10	59.55	50.11	337.10	326.60
35	18.624821	78.625961	Sirikonda	Sirikonda	199.00	173.20	45.54	40.70	183.80	162.50
36	18.604190	78.449527	Sirikonda	Chinawalgot	356.70	287.50	58.87	48.82	356.80	300.00
37	18.538677	78.430895	Sirikonda	Gadkole	178.30	159.70	25.66	20.79	177.60	159.60
38	18.511274	78.501071	Sirikonda	Pakala	193.50	160.80	46.54	37.31	194.50	176.30
39	18.549966	78.545862	Sirikonda	Chimanpalle	158.60	149.70	42.65	36.82	182.20	167.70
40	18.540901	78.386655	Sirikonda	Honnajipet	173.70	131.60	43.18	38.34	198.50	176.40
				MIN	143.10	101.20	19.74	14.69	132.30	114.80
				MAX	389.50	297.50	69.97	60.11	356.80	326.60
				Mean	220.94	174.44	47.41	39.95	228.58	197.74
				SD	69.95	56.73	10.19	9.13	66.56	61.38

Conclusion

Study revealed that turmeric growing soils of Nizamabad district, Telangana are slighty acidic to alkaline in pH and non-saline in nature which were suitable for crop growth. The organic carbon was ranged from low to high. Available nitrogen was low to medium in ramge. Low to high in available phosphorus and potassium, majority of soils are medium in range and decrease in nutrients with increase in depth was observed. All the macro and micronutrients were positively correlated with organic carbon.

Acknowledgements

I extend my heartfelt gratitude to my advisor, Dr. G. Kiran Reddy, Assistant Professor, Department of Soil Science and Agricultural Chemistry, Professor Jayashankar Telangana State Agricultural University, for his unwavering support, expert guidance, and thoughtful suggestions that were instrumental throughout the duration of this work. I also extend my gratitude to all the teaching and non- teaching staff of our department because without their support, I would not have been able to complete my work.

References

1. Arya S, Singh R, Jat MK, Yadav PK. Characterization and classification of ber (*Ziziphus mauritiana*) growing soils of Rewari district, Haryana. J Soil Salin Water Qual. 2024;16(1):1-15.
2. Dinssa B, Elias E. Characterization and classification of soils of bako tibe district, west shewa, Ethiopia. Heliyon. 2021;7(11).
3. Food and Agriculture Organization of the United Nations. Status of the world's soil resources: main report. 2021.
4. Gowthamchand, Dhaliwal SS, Sharma V, Verma G, Singh J, Kaur M. Variation of physico-chemical properties among

different soil orders under different land use systems of the majha region in north-western India. Sustain. 2023;15(6):4779.
5. Gurudev D, Naidu MVS, Vasu D, Reddy GK, Leelavathy GP. Characterization, classification and evaluation of soils in semi-arid ecosystem of Karvetinagram Mandal of Chittoor district, Andhra Pradesh. J Indian Soc Soil Sci. 2024;72(4):365-376.
6. Jackson ML. Soil chemical analysis. New Delhi: Prentice Hall of India (Pvt.) Ltd.; 1973. p. 1-498.
7. Malavath RN, Thurpu SR. Soil quality assessment of some turmeric growing areas in relation to root-knot Nematodes status of Nizamabad district of Telangana. J Pharmacogn Phytochem. 2019;8(1):920-925.
8. Olsen SR, Cole CV, Watanabe FS, Dean LA. Estimation of available phosphours in soils by extraction with sodium bicarbonate. Circular of United States Department of Agriculture. 1954;939.
9. Prasad V, Anjaiah T, Reddy KP, Laxminarayana P. Nutrient status of soils from the Kaleshwaram project command area of erstwhile Nizamabad district in Telangana state. Int J Environ Clim Change. 2022;42-54.
10. Pattnaik T, Dash PK, Mishra A, Balabantaray S, Dugal D. Assessing vertical heterogeneity of soil properties and nutrient availability in two distinct landforms of dhenkanal district, Odisha, India. Plant Arch. 2025;25(1):1045-1046.
11. Poojitha M, Reddy GK, Reddy KPC, Pasha ML. Impact of land use systems on soil phosphorus and potassium in Khammam district, Telangana state. Int J Res Agron. 2024;7(8):137-140.
12. Pal SK, Mukhopadyay AK. Distribution of different forms of potassium in profiles of some Entisols. J Indian Soc Soil Sci. 1992;40:371-373.
13. Rajeswar M, Khan MA. Characterization and classification of forest soils of Nizamabad district of Andhra Pradesh. An Asian J Soil Sci. 2008;3:11-16.
14. Triveni S, Neelima TL, Reddy GKR, *et al*. Soil fertility mapping of Patancheru area, Sanga Reddy district Telangana by using GPS-GIS. J Res, PJTSAU. 2022;49(4).
15. Reddy GK, Sharma SHK, Jayasree G, Hussain SA, Triveni S, Neelima TL. Assessment of spatial variability of soil fertility status of Nagarjuna Sagar Left Bank command area in Nalgonda district, Telangana using GIS-GPS. J Pharm Innov. 2021;10(7):481-489.
16. Singh RS, Singh KP, Raghubanshi AS. Influence of potassium fertilization on growth and yield of turmeric. J Plant Nutr. 2010;33(10):1481–1490.
17. Subbaiah BV, Asija CL. A rapid procedure for the estimation of available nitrogen in soils. Curr Sci. 1956;25:32.
18. Vasundhara R, Srinivasan R, Dharumarajan S, Kalaiselvi B, Hegde R. Characterization and classifications of soils of Eastern Ghats region of Karnataka. Agropedology. 2022;32(2):200-210.
19. Walkley A, Black CA. Estimation of organic carbon by chromic acid titration method. Soil Sci. 1934;37:29-38.