Physico-chemical Properties of Cotton Growing Soils in Uppununthala Mandal, Nagarkurnool District, Telangana, India

Nirmitha Mareddy [a++*], **Ommala D. Kuchanwar** [b#],
Nishigandha R. Mairan [b†], **Brishmrita M. Das** [a++],
Hrushikesh B. Gund [a++] **and Padmaja H. Kausadikar** [b†]

*[a] Soil Science and Agricultural Chemistry Section, College of Agriculture, Nagpur,
Dr. PDKV, Akola, Maharashtra-444104, India.*
[b] Soil Science and Agricultural Chemistry Section, College of Agriculture, Nagpur, India.

Authors' contributions

Original Research Article

ABSTRACT

The aim of this study is the evaluation of soil fertility in the Uppununthala mandal of the Nagarkurnool district, Telangana. In total, fifty surface soil samples (0-20 cm) were analysed for various soil fertility parameters, *viz.*, pH, EC, organic carbon, available N, P, K, S by standard procedures. The results revealed that, the pH of the soils of the study area were neutral to slightly alkaline (7.14 - 8.30) in nature. The electrical conductivity (0.14 to 0.55 dS m^{-1}) was within safe

[++] *PG student;*
[#] *Professor (CAS);*
[†] *Assistant Professor;*
Corresponding author: E-mail: nirmithamareddy03@gmail.com;

limits. Organic carbon ranged from low to medium (1.9 - 7.9 g kg^{-1}) in the soils. The data on nutrient status showed that, the available nitrogen (125.44 - 291.64 kg ha^{-1}) was low, while available phosphorus (9.7 - 26.2 kg ha^{-1}) was low to medium and potassium (123.20 - 360.64 kg ha^{-1}) were medium in range. The available sulphur content ranged in medium level (10.56 to 20.62 mg kg^{-1}).

1. INTRODUCTION

Soil is the precious natural resource and has the greatest significance as it is the cradle of all crops and plants. This is the reserve of nutrients that play an important role in crop development [1]. In India, the limited availability of soil resources for agriculture diminishes and optimize the use of these resources with intensification of agriculture which results in the rapid depletion of the nutrients. It is therefore essential to regularly monitor the fertility status of the soil from time to time in order to sustain the soil health. Soil fertility is one of the primary constraints to agricultural production in developing countries such as India [2]. At present nutrient extraction is a major threat to Indian agriculture as there is a wide gap between nutrient addition and nutrient elimination. Consequently, soil dynamics can be better understood by understanding the physical and chemical properties of soil.

A major part of the country's industrial and agricultural economies relies on cotton, one of the most valuable fiber and cash crop of India. Among the cotton growing states, Telangana stands in 3rd position with an area of 21.27 lakh hectares. The production was 58 lakh bales accounting for productivity of 418 kg ha^{-1} [3]. In order to optimize crop yield, soil testing is the basis for fertilizer recommendation to keep soil fertility at its optimal level over time [4]. Furthermore, no detailed studies on the status of nutrients in the Uppununthala region of Telangana have been conducted so far. Hence, present investigation was undertaken to study the status of physico-chemical properties in Uppununthala mandal, Nagarkurnool district of Telangana.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted in Uppununthala mandal, which lies between 16.480864°N 78.634415°E at an elevation of 545 m above mean sea level (MSL) covering an area of 220 km^2. In the study area, the climatic condition is predominantly semi-arid, with the mean annual rainfall of about 642 mm. The soils of this area are red and black associated soils (red sandy soil, chalka soil and black cotton soils).

2.2 Data and Methods

Totally 50 surface samples covering cotton growing areas of 10 villages were randomly collected at 0-20 cm depth using standard soil sample sampling methods. Collected soil samples were air dried, gently ground, and sieved using a 2 mm sieve for pH, EC, and Available N, P, K, and S analysis, whereas for organic carbon analysis 0.5 mm sieved soil was used. The processed soil samples were analysed for different parameters by using standard analytical techniques. In 1:2.5 suspension, the pH and electrical conductivity (EC) of soil samples were determined [5]. The organic carbon (OC) content was determined by Walkley and Black [6] method. Alkaline permanganate method was used to estimate available N [7], available P was extracted using 0.5 N NaHCO$_3$ extractant [8] and the extracted K was determined with the help of 1N ammonium acetate by using flame photometer as described by Jackson [5]. Available sulphur was extracted by 0.15 percent CaCl$_2$ and estimated by turbidimetry method [9].

3. RESULTS AND DISCUSSION

In the study area, soil reaction in the surface soils varied from 7.14 to 8.30 with a mean value of 7.66. The soil reaction of the surface soil was neutral to slightly alkaline in nature. The EC of soils is regulated by the amount of moisture held by its particles. The spatial distribution of EC in the soil indicates that the mean value is 0.27 dS m^{-1} and ranged from 0.14 to 0.55 dS m^{-1} which indicates the soil samples were within the normal and safe range. The mean values of EC furnished in the Table 1 shows that the highest EC (0.31 dS m^{-1}) was found in the village Ayyavaripalle and the lowest was observed in Veltur (0.22 dS m^{-1}). The low EC may be due to

free seepage conditions which facilitate the removal and release of bases by percolating and drainage water [10].

The perusal of the investigation revealed that, organic carbon in the soils scaled from 1.9 to 7.9 g kg^{-1} with an average value of 4.30 g kg^{-1}. The highest and lowest mean of organic content was found in Koratikal, Thippapur (5.1 g kg^{-1}) and Veltur (3.5 g kg^{-1}), respectively. The low organic carbon may be attributed to the semi-arid condition of the region, where the decomposition of organic matter is faster, with little or no addition of organic residues and low vegetation cover, thereby leading to low accumulation of organic carbon in the soils [11,12]. The high content of OC in some parts of the project villages can be attributed to the addition of organic residues and its subsequent decomposition. Similar findings were also reported by Agarkar et al. [13].

The available nitrogen content in the soils ranged from 125.44 - 291.64 kg ha^{-1} with an average value of 184.64 kg ha^{-1}. The lowest available nitrogen content was observed in Lathifpur village (162.44 kg ha^{-1}) and highest in Ayyavaripalle village (229.55 kg ha^{-1}). Low soil nitrogen may be due to the fact that all the factors favouring the nitrogen loss are prevalent in the study area, including, high temperatures leading to the process of volatilization, erosion, crop removal and insufficient rain [14]. Similar findings were also reported by Kumar and Naidu [15].

The range of the soils available phosphorus content was 9.7 to 26.2 kg ha^{-1}, with a mean value of 16.83 kg ha^{-1}. The soils of Veltur had the lowest amount of phosphorus (12.72 kg ha^{-1}) whereas, Vigneswarpur had the maximum amount (19.32 kg ha^{-1}). Due to the continuous use of high analysis fertilizers, particularly DAP, without knowledge of crop needs, the region's semi-arid climate, which has little rainfall and a high availability of soil phosphorus, may have contributed to the build-up of available phosphorus status in these soils. Vedadri and Naidu [16] also concluded similar results from their study.

The available potassium in the soils of Uppununthala tehsil is on a scale of 123.20 to 360.64 kg ha^{-1} with an average of 227.38 kg ha^{-1}. The lowest potassium content was found in the soils of Lathifpur (187.49 kg ha^{-1}) whereas, the highest potassium content was found in the soils of Thippapur (276.19 kg ha^{-1}). The higher potassium in some of the soils can be due to intense weathering, high application of potassic fertilizers and release of liable potassium from mica-rich minerals. These results were in accordance with Gangothri and Dadhich [17].

The magnitude of the available sulphur content in the soils was observed to be in the tune of 10.56 to 20.62 mg kg^{-1} (mean of 14.68 mg kg^{-1}). The available sulphur content was found to be highest in Veltur, with a mean value of 17.01 mg kg^{-1} whereas, the lowest sulphur content was found in the soils of Tadoor with a mean value of 13.05 mg kg^{-1}. Similar results were reported by Sekhar et al. [18].

Table 1. Physico-chemical properties of soil

| S. No.	Name of the village	pH 1:2.5	EC dS m^{-1}	OC g kg^{-1}	Avail-N kg ha^{-1}	Avail-P kg ha^{-1}	Avail-K kg ha^{-1}	Avail-S mg kg^{-1}
1.	Veltur	7.61	0.22	3.5	175.61	12.72	196.40	17.01
2.	Ayyavaripalle	7.58	0.31	4.3	229.55	18.50	208.10	15.16
3.	Koratikal	7.69	0.24	5.1	200.69	18.22	251.33	14.92
4.	Thippapur	7.83	0.25	5.1	178.75	19.04	276.19	14.68
5.	Tadoor	7.85	0.30	3.6	168.08	15.58	212.35	13.05
6.	Vigneswarpur	7.61	0.26	4.1	176.86	19.32	218.62	14.70
7.	Uppununthala	7.46	0.29	4.5	193.17	17.96	236.54	13.69
8.	Lathifpur	7.60	0.25	3.8	162.44	15.12	187.49	13.70
9.	Penmilla	7.65	0.29	3.6	163.07	14.92	243.49	13.77
10.	Kamsanipalle	7.72	0.25	5.0	198.19	17.90	245.06	16.13
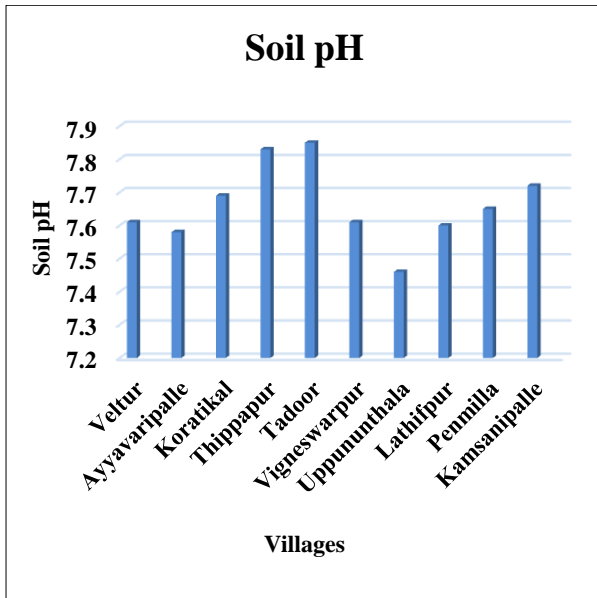
Fig. 1a. Village wise mean pH of soils in Uppununthala mandal
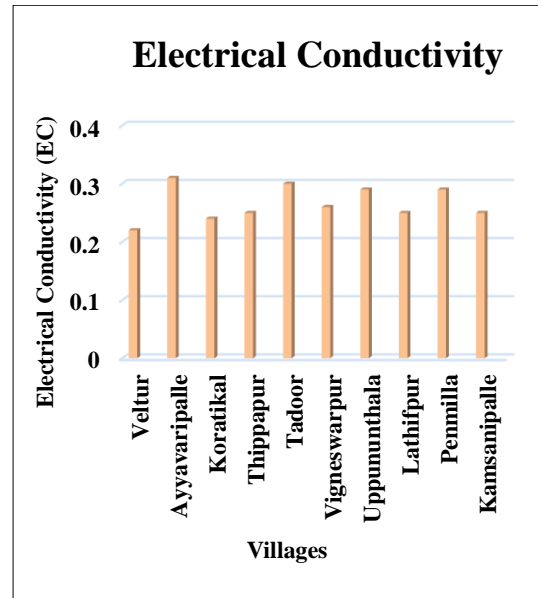

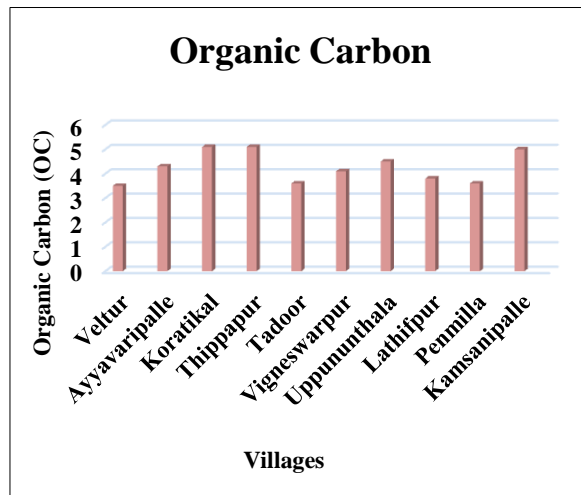**Fig. 1b. Village wise mean EC of soils in Uppununthala mandal**

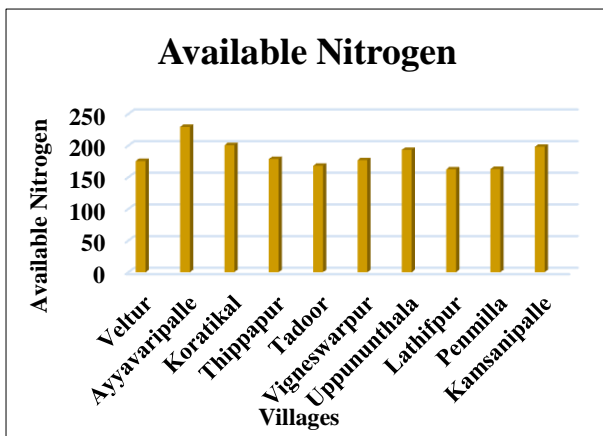**Fig. 1c. Village wise mean OC of soils in Uppununthala mandal**

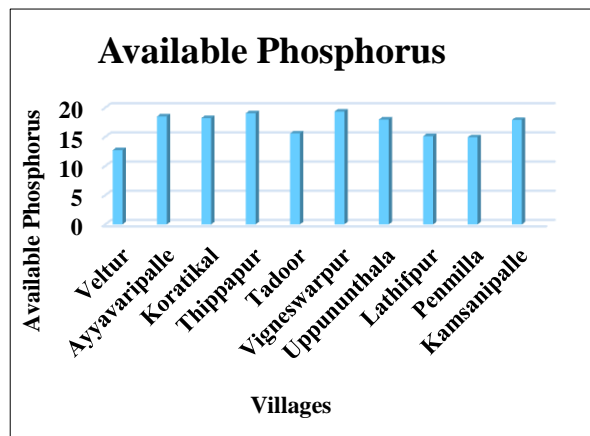**Fig. 1d. Village wise mean Avail-N of soils in Uppununthala mandal**

Fig. 1e. Village wise mean Avail-P of soils in Uppununthala mandal

Available Potassium
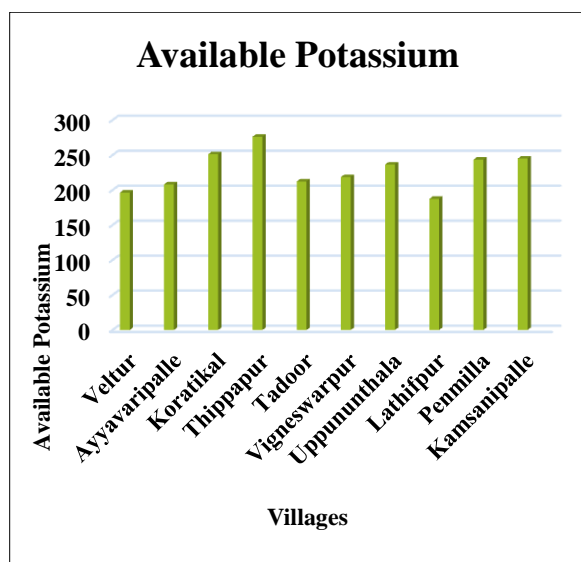
Available Sulphur

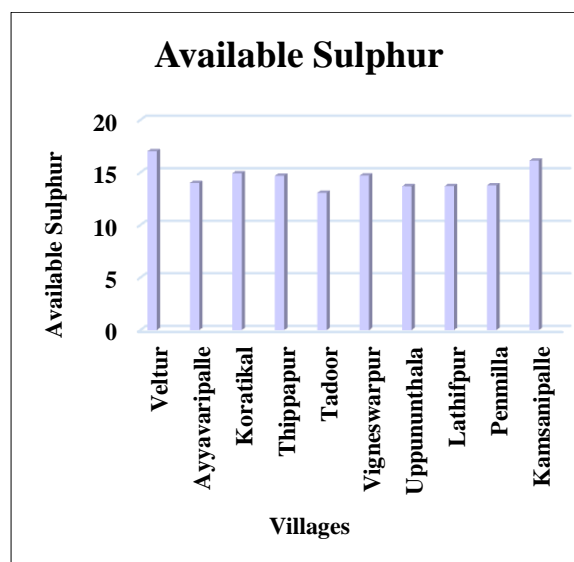**Fig. 1f. Village wise mean Avail-K of soils in Uppununthala mandal**

Fig. 1g. Village wise mean Avail-S of soils in Uppununthala mandal

Fig. 1. Chemical properties and status of available macronutrients in soil

4. CONCLUSION

In the present study, soils of Uppununthala mandal, Nagarkurnool district, Telangana were neutral to slightly alkaline in reaction, all the soil samples of the study were within the safe range for electrical conductivity. The organic carbon content of the soils varied from low to medium. The available nitrogen was low, available potassium, sulphur in the soils were medium. However, the phosphorus content of the soils was low to medium. Consequently, the soils of the study area need an attention in terms of efficient nutrient management practices and regular tracking of soil health in order to improve the yields.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Singh A, Pandey AK, Singh U. A study on soil fertility status of adopted model village in Rahuamani, Kahra block of Saharsa district in Bihar. World Journal of Advanced Research and Reviews. 2022; 14(2):167-173.
2. Desavathu RN, Nadipena AR, Peddada JR. Assessment of soil fertility status in Paderu Mandal, Visakhapatnam district of Andhra Pradesh through Geospatial techniques. The Egyptian Journal of Remote Sensing and Space Science. 2018;21(1):73-81.
3. CCI; 2020.
   Available:https://www.cci.gov.in
4. Singh VK, Gautam P, Nanda G, Dhaliwal SS, Pramanick B, Meena SS, Alsanie WF, Gaber A, Sayed S, Hossain A. Soil test-based fertilizer application improves productivity, profitability and nutrient use efficiency of rice (*Oryza sativa* L.) under direct seeded condition. Agronomy. 2021; 11(9):1756.
5. Jackson ML. Soil chemical analysis. Prentice Hall India Pvt. Ltd., New Delhi. 1973;69-182.
6. Walkley AJ, Black AI. Estimation of soil organic carbon by the chromic acid titration method. Soil Science. 1934;37:29-38.
7. Subbiah BV, Asija CL. A rapid procedure for the estimation of available nitrogen in soils. Current Science 1956;25:259-260.
8. Olsen SR. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. US Department of Agriculture. 1954;939:1-19.
9. Chesnin L, Yien CH. Turbidimetric determination of available sulphates. Soil Science Society of America Journal 1951;15:149-151.

10. Vandana S, Reddy P, Nagamadhuri K, Reddy PM. Soil fertility status of gudipala mandal of Chittoor district, Andhra Pradesh for site specific recommendations. Andhra Pradesh J Agril. Sci. 2021;7(2):76-80.

11. Sashikala G, Naidu MVS, Ramana KV, Nagamadhuri KV, Reddy A, Sudhakar P, Krishna TG. Characterization and classification of soils in semi-arid region of Tatrakallu village of Anantapuramu District in Andhra Pradesh. Journal of the Indian Society of Soil Science. 2019;67(4): 389-401.

12. Deshmukh KK. Evaluation of soil fertility status from Sangamner area, Ahmednagar district, Maharashtra, India. Rasayan Journal of Chemistry. 2012;5(3):398-406.

13. Agarkar DV, Ingle SR, and Hemant K. Characterization of some cotton growing soils of Wardha district of Vidharbha region (MS, India). Journal of Soils and Crops. 2012;22(1):159-167.

14. Shivanna AM, Nagendrappa G. Chemical analysis of soil samples to evaluate the soil fertility status of selected command areas of three tanks in Tiptur Taluk of Karnataka, India; 2014.

15. Kumar YS, Naidu MVS. Characteristics and classification of soils representing major land forms in Vadamalalpeta mandal of Chittoor district, Andhra Pradesh. Journal of the Indian Society of Soil Science. 2012;60(1):63-67.

16. Vedadri U, Naidu MV. Characterization, classification and evaluation of soils in semi-arid ecosystem of Chillakur mandal in SPSR Nellore district of Andhra Pradesh. Journal of the Indian Society of Soil Science. 2018;66(1):1-9.

17. Gangothri N, Dadhich AS. A study on the availability of micro and macro nutrients in red and black agricultural soils of Eklaskhampeta, Telangana, India; 2009.

18. Sekhar CC, Naidu MVS, Ramprakash T, Balaguravaiah D. Genesis, characterization and classification of soils from selected parts of Prakasam district in Andhra Pradesh, India. Journal of Pharmacognosy and Phytochemistry. 2019;8(1):51-58.

_____

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/95045