Original Research Article

Physico-chemical properties of cotton growing soils in Uppununthala mandal, Nagarkurnool district, Telangana

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 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 (125.44 - 291.64 kg ha^{-1}) was low to medium and potassium (123.20 - 360.64 kg ha^{-1}) were medium. The available sulphur content ranged in medium level (10.56 to 20.62 mg kg^{-1}).

Keywords: Soil fertility status, available nutrients, physico-chemical properties.

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 resolve of nutrients that play an important role in crop development (Singh *et al*., 2022). 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 (Desavathu *et al*., 2018). 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 ha. The production was 58 lakh bales accounting for productivity of 418 kg ha^{-1} (CCI, 2020). In order to optimize crop yield, soil testing is the basis for fertilizer recommendation to keep soil fertility at its optimal level over time (Singh *et al*., 2021). Furthermore, no detailed studies on the status of nutrients in the Uppununthala region of Telangana have been conducted thus 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

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).

Totally 50 surface soil samples covering cotton growing area of 10 villages in Uppununthala mandal of Nagarkurnool district were collected randomly at 0-20 cm depth using standard procedures of soil sample collection. Soil samples were air dried, gently bound, and sieved using a 2 mm sieve for almost all analysis, with a 0.5 mm sieve used only to estimate organic matter. The nutrient availability of the processed soil samples was determined using standard analytical techniques. The pH and electrical conductivity (EC) of soil samples were decided in 1:2.5 soil: water suspension (Jackson, 1973). The organic carbon (OC) content was determined by

Walkley and Black (1934). Alkaline permanganate method was used to estimate available N (Subbiah and Asija, 1956), available P was extracted using 0.5 N $NaHCO_3$ extractant (Olsen *et al.*, 1954) and the extracted K was determined with the help of 1N ammonium acetate by using flame photometer as described by Jackson (1973). Available sulphur was extracted by 0.15 percent $CaCl_2$ and estimated by turbidimetry method according to the procedure outlined by Chesnin and Yien (1951).

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}. The soil samples were within the normal and safe range. The mean values of EC furnished in the table 1 shows that the highest mean (0.31 dS m^{-1}) was found in the village Ayyavaripalle and the lowest mean 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 (Vandana *et al*., 2021).

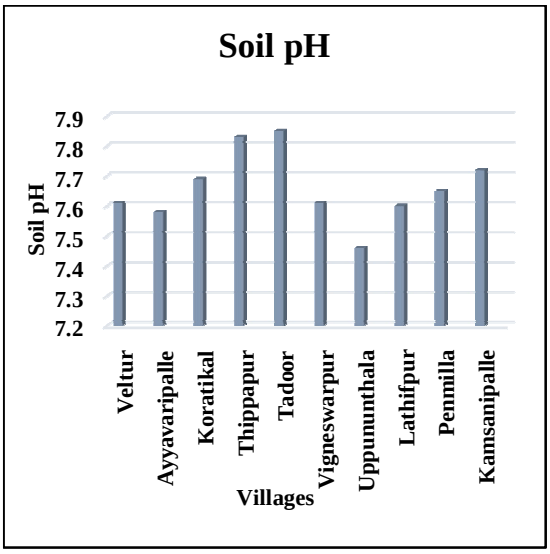
The perusal of the investigation revealed that, organic carbon in the soils scaled from 1.9 to 7.9 g kg^{-1} with an average value of 4.30 g kg^{-1}. The highest and lowest mean of organic content was found in Koratikal, Thippapur (5.1 g kg^{-1}) and Veltur (3.5 g kg^{-1}), respectively. The low organic 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 (Sashikala, 2019). 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.* (2012).

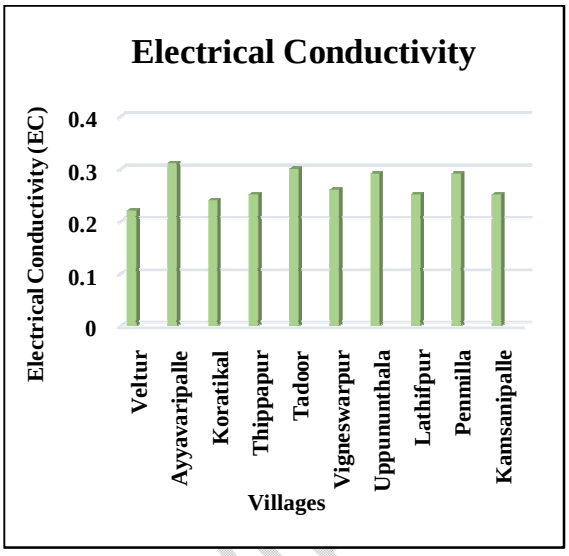
The available nitrogen content in the soils ranged from 125.44 - 291.64 kg ha^{-1} with an average value of 184.64 kg ha^{-1}. The lowest available nitrogen content was observed in Lathifpur village (162.44 kg ha^{-1}) and highest in Ayyavaripalle village (229.55 kg ha^{-1}). Low soil nitrogen may be 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 (Shivanna and Nagendrappa, 2014). Similar findings were also reported by Kumar and Naidu (2012).

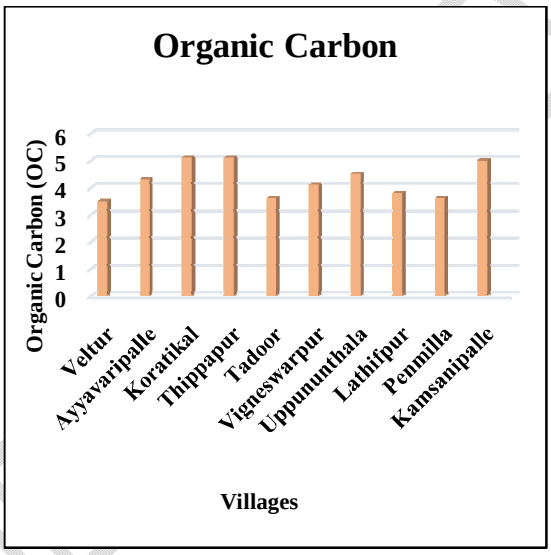
The available phosphorus content in the soils was found in a magnitude of 9.7 to 26.2 kg ha^{-1} with a mean value of 16.83 kg ha^{-1}. The lowest phosphorus content was found in the soils of Veltur (12.72 kg ha^{-1}) whereas, the highest was found in Vigneswarpur (19.32 kg ha^{-1}). Using of high analysis fertilizers especially DAP continuously without knowing the requirement of the crop, the prevailing semi-arid environment in the region with low rainfall and higher availability of soil phosphorus may have resulted in the build-up of available phosphorus status in these soils. Vedadri and Naidu (2018) also concluded similar results from their study.

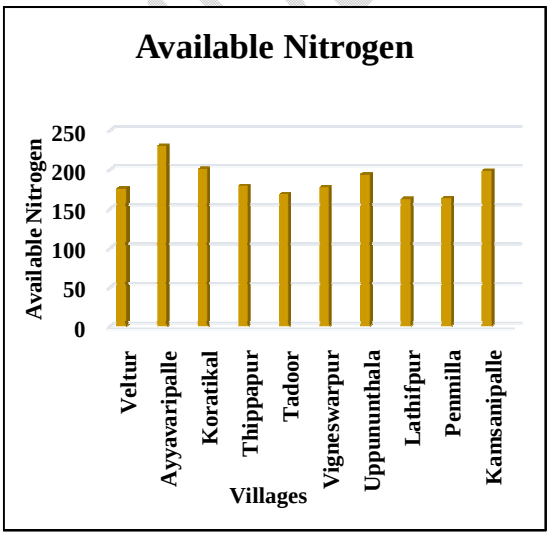
The available potassium in the soils of Uppununthala tehsil is on a scale of 123.20 to 360.64 kg ha^{-1} with an average of 227.38 kg ha^{-1}. The lowest potassium content was found in the soils of Lathifpur (187.49 kg ha^{-1}) whereas, the highest potassium content was found in the soils of Thippapur (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 (2020).

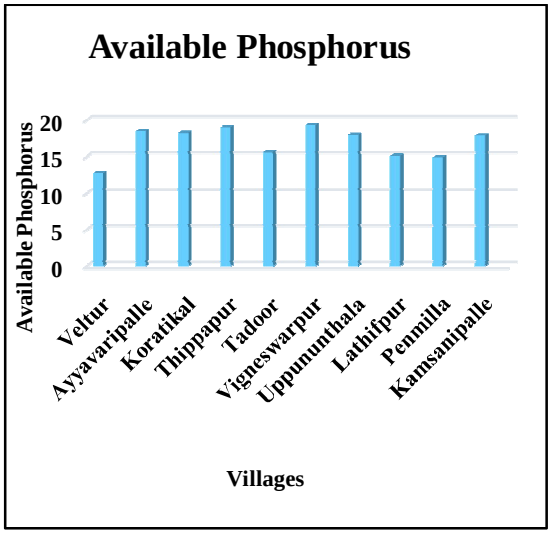
The magnitude of the available sulphur content in the soils was observed to be in the tune of 10.56 to 20.62 mg kg^{-1} (mean of 14.68 mg kg^{-1}). The available sulphur content was found to be highest in Veltur, with a mean value of 17.01 mg kg^{-1} whereas, the lowest sulphur content was found in the soils of Tadoor with a mean value of 13.05 mg kg^{-1}. This finding was supported by previous findings of Sekhar *et al.* (2019).

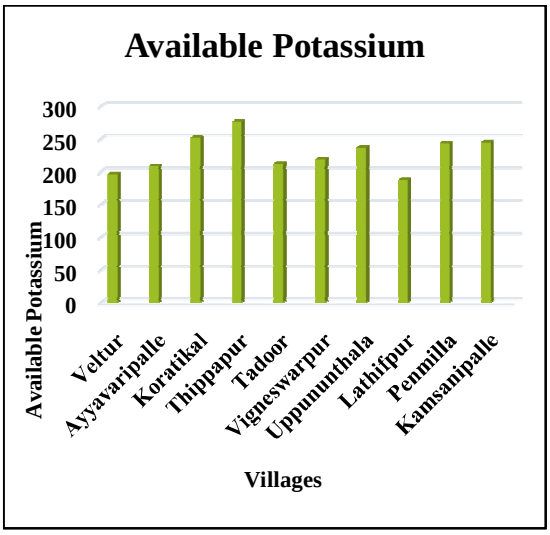

Soil pH
Soil pH
7.9
7.8
7.7
7.6
7.5
7.4
7.3
7.2
Veltur
Ayyavaripalle
Koratikal
Thippapur
Tadoor
Vigneswarpur
Uppununthala
Lathifpur
Penmilla
Kamsanipalle
Villages


Electrical Conductivity
Electrical Conductivity (EC)
0.4
0.3
0.2
0.1
0
Veltur
Ayyavaripalle
Koratikal
Thippapur
Tadoor
Vigneswarpur
Uppununthala
Lathifpur
Penmilla
Kamsanipalle
Villages


Organic Carbon
Organic Carbon (OC)
6
5
4
3
2
1
0
Veltur
Ayyavaripalle
Koratikal
Thippapur
Tadoor
Vigneswarpur
Uppununthala
Lathifpur
Penmilla
Kamsanipalle
Villages


Available Nitrogen
Available Nitrogen
250
200
150
100
50
0
Veltur
Ayyavaripalle
Koratikal
Thippapur
Tadoor
Vigneswarpur
Uppununthala
Lathifpur
Penmilla
Kamsanipalle
Villages


Available Phosphorus
Available Phosphorus
20
15
10
5
0
Veltur
Ayyavaripalle
Koratikal
Thippapur
Tadoor
Vigneswarpur
Uppununthala
Lathifpur
Penmilla
Kamsanipalle
Villages



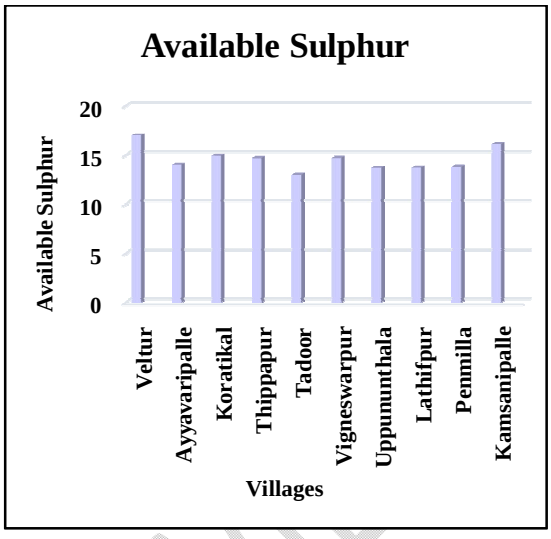


Figure 1: Chemical properties and status of available macronutrients in soil

4. Conclusion

In the present study, soils of Uppununthala mandal, Nagarkurnool district, Telangana were neutral to slightly alkaline in reaction, with all of the soil samples within the safe limit 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. The sulphur content of the soils was medium. Consequently, to increase yields, the soils of the study area require attention with respect to proper nutrient management practices and regular tracking of soil health.

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Table 1: Chemical properties of soil

Sr. No.	Name of the village	pH	EC	OC	N	P	K	S
		1:2.5	dS m^{-1}	g kg^{-1}	kg ha^{-1}	kg ha^{-1}	kg ha^{-1}	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