Biological Forum – An International Journal **14(3): 90-94(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Soil Fertility Assessment of Entisol and Vertisol orders from Ausa Tehsil of Latur District

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(Received 03 May 2022, Accepted 24 June, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Soil fertility assessment is one of the most basic decision making tool for dynamic sustainable plan of a particular area. Thus, the present study was carried out to evaluate the soil fertility status of the Entisol and Vertisol order from Ausa Tehsil of Latur District, total 100 soil samples were systematically collected from twenty villages by using global positioning system, where 40 and 10 samples identified as Entisol and Vertisol respectively, further were analyzed for their physico-chemical properties (pH, Electrical conductivity, organic carbon and calcium carbonate) and available macro nutrients (Nitrogen, Phosphorus and Potassium). The soils of Ausa tehsil were found neutral to moderately alkaline in reaction; soluble salt content comes under safe Limit *i.e.* no any deleterious effect found for all crops, where the organic carbon level exhibited low to moderately high content and non-calcareous to calcareous in nature. The NIV of Entisol and Vertisol of the area showed low content in Available N, whereas very low content for Available P, while most of the samples were found under very high content for Available K. Soils from order Entisol and Vertisol from Ausa tehsil showed positive and significant correlation between physico chemical properties (pH, EC, OC and $CaCO_3$) and available nutrients (N, P and K) respectively, yet these soils required little attention related to regular monitoring of soil health and nutrient management practices for better crop production, in future.

Keywords: Fertility status, Entisol, Vertisol, physicochemical properties, available nutrients, Nutrient Index.

INTRODUCTION

Soil fertility is an unseen factor plays an important role for making soil alive. Among the various challenges in soil system, soil fertility improvement has become major concerned day to day. The soil fertility Assessment consists of estimating the nutrient-supplying power of a particular soil. A proper soil evaluation before crop growing helps in adopting appropriate measures to make up for the shortcomings and ensuring a good crop production. Optimum productivity of any cropping system depends on ample supply of the nutrients, as an increase in cropping intensity coupled with shift from traditional varieties to that of nutrient demanding fertilizers responsive high yielding varieties have led to the large scale mining of nutrients from the soil. Due to this intensive cultivation practices and inadequate use of chemical fertilizers, the fertility and productivity of agricultural soil is deflecting. Hence the information with respect to physiochemical properties and availability of some macronutrients of the study area is lacking. Thus, it has been always considered to carry out genetic study as well as to find out fertility evaluation for making best use of the soil for crop production (Anonymous 2011). Therefore, an attempt was made to study the "fertility status of the soils from Ausa tehsil of Latur District" with the objectives to compute soil nutrient index.

MATERIALS AND METHODS

Ausa is one of the major tehsil situated at south west side of Latur district. Soils from this area belong to the order vertisol, Inseptisol and Entisol derived from Deccan trap, varied in different color due to presence of minerals like smectite, kaolinite and vermiculite. On the basis of soil depth and texture, these soils have been classified as deep to medium black and shallow black soils (Gajbe *et al.,* 1976). Soil samples collected from

the study area were dried and crushed with the help of wooden rod and passed through 2 mm sieve and then used for the determination of Physico chemical properties and available nutrient content by adopting standard laboratory method. Soil reaction (pH) and Electrical conductivity (E.C.) was determined by the procedure given by Jackson (1973). Modified method of Walkely and Black (1934) was used for determination of organic carbon. The free calcium carbonate was determined by rapid titration method as outlined by Piper (1966), available nitrogen was estimated by alkaline $KMnO_4$ method given by Subbiah and Asija (1956), available phosphorus was extracted by Olsen *et al.* (1954), available potassium was determine through the method given by Jackson (1973) respectively. Whereas the nutrient index approach introduced by Ramamurthy and Bajaj (1969) was used to evaluate the fertility status of soils based on the samples in each of the six classes. The whole data was subjected to statistical analysis by the method described by Panse and Sukhatme (1967).

RESULT AND DISCUSSION

The data (Table 1 and Fig. 1) indicated that the pH of Entisol soils varied from 7.1 to 8.6 having a mean of 7.75, while the pH of Vertisol soils was ranged from 7.1 to 8.1 with mean value of 7.63. Hence, it was clearly showed that soils of Ausa Tehsil were neutral to moderately alkaline in nature. This might be due to dominance presence of exchangeable Ca, Mg and free $CaCO_3$ with higher per cent of base saturation, Waghmare *et al.* (2008) recorded that the soils of Ausa tehsil ranged from 7.05 to 8.9 with an average value of 8.07. Similar results were also reported by Hiray and Takankhar (2013), Dhamak *et al.* (2014) respectively.

Electrical conductivity of the Entisolsoils varied from 0.28 to 0.95 dS m^{-1} with an average value of 0.93 dS m^{-1}, whereas Electrical conductivity of the vertisol soils varied from 0.28 to 0.69 dS m^{-1} with an average value 0.49 dS m^{-1} (Table 1 and Fig. 1). Results derived from the soils for EC, showed that there was no remarkable accumulation of soluble salts in soils because of sufficient flushing and leaching of soluble salts from Upper into lower layers, which happens might be due to various agronomic practices, frequently irrigation of crops and light textured nature of the soils. Hiray and Takankhar (2013) reported that the EC of soils from Tuljapur tehsil of Osmanabad varied from 0.110 to 0.810, 0.100 to 0.930 and 0.130 to 1.000 dS m^{-1} in Vertisol, Inceptisol and Entisol respectively. Similar results were also reported by Chandan *et al.* (2018); Thombe *et al.* (2020).

The data (Table 1 and Fig. 1) on organic carbon content in Entisol were ranged from 2.1 to 7.5 g $kg^{-1}$with mean value 4.6 g kg^{-1}, whereas the vertisol soils were varied from 3.5 to 7.5 g $kg^{-1}$with mean value 5.3 g kg^{-1}, From the above values it was firm that these soils come under low to medium in O.C. content. Reason behind the existence of variation in organic carbon content as Lower to medium range might be due to high temperature of Latur District (up to 41.5) and good aeration in the soil increased the rate of oxidation of organic matter resulting reduction in organic carbon content. Dhamak *et al.* (2014) found that soils from orders Vertisol, Inseptisol and Entisol varied from 1.30 to 19.90, 1.40 to 16.00 and 1.40 to 11.40 g/kg^{-1} with a mean value 5.00, 4.50 and 3.80 g kg^{-1}, respectively from Soils of Ambajogai tehsil in Beed district. This range of organic carbon indicated that the majority of these soils were low to moderately high in O.C. content. Such results were also in line with the results reported by Verma *et al.* (2013); Kumar *et al.* (2014); Narsaiah *et al.* (2018); Srinidhi *et al.* (2020).

The Calcium carbonate ($CaCO_3$) content in Entisol soils from Ausa tehsil ranged between 31 to 92 g $kg^{-1}$with an average value of 66 g kg^{-1}. The content of calcium carbonate in soils from Vertisol of Ausa tehsil varied from 31 to 83 g kg^{-1} with a mean value of 48.9 g kg^{-1} (Table 1 and Fig. 1). From the above findings it showed that these soils were non-calcareous to calcareous in nature, also the variations found in available $CaCO_3$ would be due to varying range of pH and clay content which alleviate the accumulation of $CaCO_3$ in studied soils. Waghmare *et al.* (2008) observed that the range of $CaCO_3$ in soils was varied from 0.88 to 12.6 per cent with the mean value of 4.88 per cent, which shows non-calcareous to calcareous nature of soils from Ausa tehsil in Latur district. Similar results were also noted by Nirawar *et al.* (2009) Narsaiah *et al.* (2018); Dhotare *et al.* (2019).

The available N status of Entisol soil was ranged from 140 to 271 kg ha^{-1} with a mean value of 184.4 kg ha^{-1}, while available Nitrogen content of Vertisol soils was varied from 135 to 215 kg ha^{-1} with an average value of 171.8 kg ha^{-1} (Table 2 and Fig. 1). From the above results it was observed that this soils were comes under very low to low in available Nitrogen content. The low status of available N in these soils might be due to the differential cultivation management, difference in soil physiographic properties, removal of N by growing of exhaustive crops along with limited addition of Nitrogen via organics, less accumulation of organic matter, leaching losses, Denitrification-fixation and volatization. Nirawar *et al.* (2009) stated that the available N content from Ahmedpur tehsil of Latur district was varied from 100.35 to 323.00 kg ha^{-1}. Similar findings were also confirmatory with the findings given by Shinde *et al.* (2014) and Thombe *et al.* (2020).

The content of available P (Table 2 and Fig. 1) from Entisol varied from 10.50 to 15.20 kg ha^{-1} with an average value of 12.76 kg ha^{-1}, whereas available Phosphorous from the soils under Vertisol was ranged from 11.9 to 14.5 kg ha^{-1} with a mean value of 13.39 kg ha^{-1}. Such very low to low availability of phosphorous might be caused of frequent variations in soil properties *i.e.* pH, organic matter content, texture and various agro-soil management practices, also due to increase

level of clay content in soil and higher amount of Fe-Al Hydrous oxides. Shinde *et al.* (2014) reported that the available P content was ranged from 2.42 to 19.62 kg $ha^{-1}$with a mean value of 10.23 kg $ha^{-1}$from udgir tehsil in Latur district. Similar results were also in agreement with the findings by Nirawar *et al.* (2009); Kumar *et al.* (2014); Priyanka *et al.* (2018).

The status of available K (Table 2 and Fig. 1) from studied area for Entisol soils was ranged from 256 to 868 kg ha^{-1} with an average value 517.15 kg ha^{-1}, also the available Potassium was ranged from 342 to 652 kg ha^{-1} with a mean value of 520.6 kg ha^{-1} for Vertisol soils, such higher content of available potassium resulted in the soils of Ausa Tehsil might be due to the persistence of K rich minerals in the Parent material, with presence of high clay content like Feldspars, mica and Illite etc. Waghmare *et al.* (2009) reported that the available potassium content in black soils of Ausa tehsil of Latur district varied from 141.45 to 1419 kg ha^{-1} with mean value of 532.20 kg ha^{-1}, this value indicated that soils of Ausa tehsil were medium to high in available K content. Similar findings were also noted by Dhamak *et al.* (2014); Kumar *et al.* (2014); Biradar (2018); Kashiwar *et al.* (2019).

Table 1: Status of physico chemical properties for Entisol and Vertisol soil order from Ausa tehsil.

Soil Order	Parameters	pH	EC (dSm^{-1})	OC (g/kg^{-1})	$CaCO_3$(g/kg^{-1})
Entisol (40 samples)	**Range**	7.1-8.6	0.28-0.95	2.1-7.5	31 – 92
	Mean	7.75	0.63	4.6	66
Vertisol (10 samples)	**Range**	7.1-8.1	0.28-0.69	3.5-7.5	31-83
	Mean	7.63	0.49	5.3	48.9

Table 2: Status of available Macro nutrients for Entisol and Vertisol soil order from Ausa tehsil.

Soil Order	Parameters	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})
Entisol (40 samples)	**Range**	140-271	10.5-15.2	256-868
	Mean	184.4	12.76	517.15
Vertisol (10 samples)	**Range**	135-215	11.9-14.5	342-652
	Mean	171.8	13.39	520.6

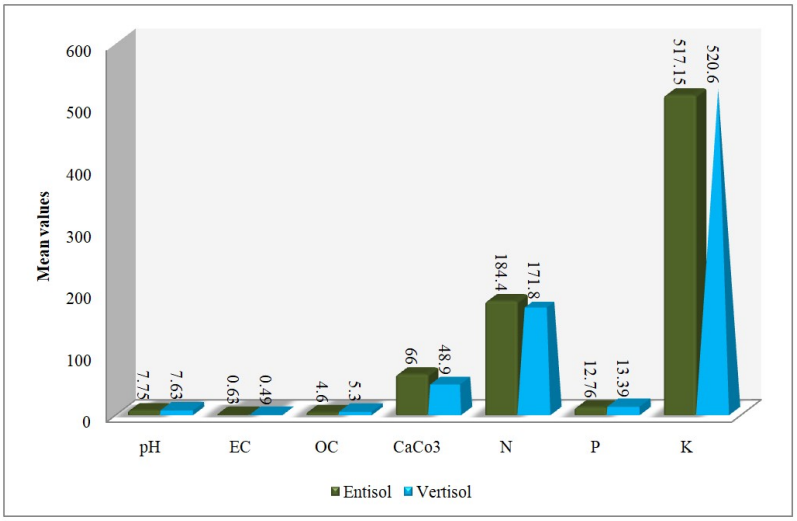

Fig. 1. Diagrammatic representation of physico chemical properties and available macro nutrients forEntisol and Vertisol soil order from Ausa tehsil.

Nutrient index Value of Entisol and Vertisol Soils from Ausa tehsil. Considering soil nutrient index for soils of Ausa Tehsil represented in Table 3 and Fig. 2, itt was revealed that these soils were mostly distributed under Low for available Nitrogen, low for available Phosphorous while very high for available Potassium. The NIV resulted according to Ramamoorthy and Bajaj (1969) was 0.98 and 0.95 for available N, 0.50 and 0.50 for Available P, whereas available K, 2.92 and 2.95 for Entisol and Vertisol orders respectively, against the NIV rating < 0.75 for very low, 0.75 – 1.25 for Low and > 2.75 for Very high fertility status of area. On the basis of resulted nutrient index value for available Nitrogen soils from Ausa tehsil was categorized in very low to low content. As Nitrogen already the limiting nutrient for the growth and development of plants, reason behind this might be due to hot and dry climate condition associated with this region, limited addition of Nitrogen via organics, less accumulation of OM in these soils etc. To overcome these critics it is mandatory to apply organic wastes and matter as an important source of nutrient to the agricultural soils, also expected to added N fertilizers to the greater magnitude.

Table 3: Nutrient Index Value of Ausa Tehsil from Latur.

Sr. No.	Available Nutrients	NIV		Category
		ENTISOL	VERTISOL	
1.	N	0.98	0.95	Low
2.	P	0.50	0.50	Very Low
3.	K	2.92	2.95	Very High

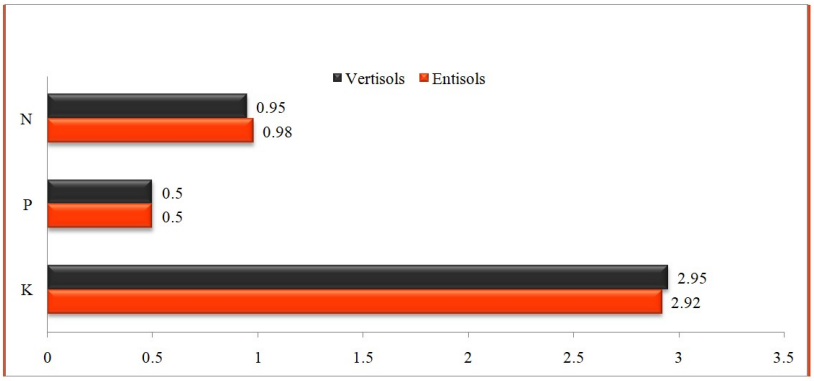

Fig. 2. Nutrient Index value of Entisol and Vertisol soils from Ausa Tehsil.

The available Phosphorous status in Ausa tehsil soils was found in category very low to low, this might be due to frequent fluctuation in soil properties and also Continuous mining by the crops from soils and higher amount of $CaCO_3$ in these soil which get fix the native and applied phosphorous in soil, to enrich such agricultural field it can be supplemented by applying Phosphorous rich fertilizers to the soils.

The NIV of Available potassium reported that the soils from studied area were found under very high fertility status, such higher availability of potassium in soils might because of the K bearing minerals and high content of clay present in the soils.

Correlation of physicochemical characteristic with availability of Nutrients from soil orders Entisol and Vertisol of Ausa Tehsil. The data on correlation between Physico chemical properties with available nutrients status of Entisol and Vertisol of Ausa tehsil were depicted in (Table 4) Entisol and Vertisol soils from Ausa tehsil showed positive and significant correlation between physico chemical properties (pH, EC, OC and $CaCO_3$) and available nutrients (N, P and K), respectively.

Table 4: Data on correlation for soils of Ausa tehsil.

Correlation	Entisol			Vertisol		
	N	P	K	N	P	K
pH	0.913**	0.851**	0.901**	0.885**	0.98**	0.865**
EC	0.864**	0.665**	0.779**	0.881**	0.963**	0.908**
OC	0.708**	0.755**	0.789**	0.906**	0.958**	0.893**
$CaCO_3$	0.803**	0.564**	0.674**	0.912**	0.833**	0.838**

* Significant at 5 % level ** Significant at 1 % level

CONCLUSION

This analysis may help farmers to add deficient nutrients to obtain high quality products with high yield. According to the soil test resultsit can be concluded that most of the Entisol and Vertisol orders from Ausa tehsil showed very low to low in available N and P, moderately high to very high level in available K and characterized under neutral to moderately alkaline in soil reaction (pH) and less than 1.0 dS m^{-1} soluble salt content (EC) which comes under safe limit for all soils. The organic carbon level exhibited low to medium whereas non-calcareous to calcareous in nature were found. The Physico chemical properties (pH, EC, OC and $CaCO_3$) of soils from order Entisol and Vertisol showed strongly positive and significant relation with available nutrients (N, P and K).Still improvements in future have to be done to improve the soil quality by practicing the better cropping systems instead of continuous cropping.

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How to cite this article: Kadam Dhiraj Madhav, Waghmare Mahesh Shivachandra, Lingayat Nagesh Radhakishan, Goswami Harish Giri, Chavan Nishigandha Satish and Kumawat Hemraj (2022). Soil Fertility Assessment of Entisol and Vertisol orders from Ausa Tehsil of Latur District. *Biological Forum – An International Journal*, *14*(3): 90-94.