Quest Journals
Journal of Research in Agriculture and Animal Science
Volume 2 ~ Issue 10 (2014) pp: 35-39
ISSN(Online) : 2321-9459
www.questjournals.org

Research Paper

Identification of Major Soil Nutritional Constraints in Vertisol, Inceptisol and Entisol from Ambajogai Tahsil of Beed District

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Received 17 December, 2014; **A**ccepted 31 December, 2014 © The author(s) 2014. Published with open access at **www.questjournals.org**

ABSTRACT:- The study was conducted on Vertisols, Inceptisols and Entisols located in Ambajogai tahsil of Beed district and the purpose to evaluate the major soil nutritional constrains for addressing fertility indices of soil. For this purpose 140 representative soil samples were collected at 0-20 cm depth from different villages of Ambajogai tahsil. These soil samples were analyzed for physico-chemical properties and status of available P, K, S, exchangeable Ca, and Mg. These soil samples were analyzed for soil properties and fertility status of soil. The soils under the study were neutral to alkaline in reaction, safe in limit of electrical conductivity and moderately calcareous to calcareous in nature. These soils were low to high in content of organic carbon. The soil samples were low in available N and P and high in available K. While, the exchangeable Ca and available S were in sufficient quantity, while exchangeable Mg ranged from low to high. However, the organic carbon showed positive and significant correlation with available N, P, K pH and $CaCO_3$ showed negative. According to nutrient index value of the soils of Ambajogai tahsil were found in low category for available N and P, while high with respect to available K, S and exchangeable Ca, whereas medium for exchangeable Mg.

***Keywords*:-** Soil properties, nutrient index, Ca, Mg, S.

I. INTRODUCTION

To ensure sustainability of our production system, it is essential to understands oil as valuable natural resource (Sehgal, 2002). The major nutrients govern the fertility of the soils and control the yield of crops. Soil fertility evaluation of an area or region is an important aspect in context of sustainable agricultural production. In present era of technological advancement in agriculture it is of immense interest to study the fertility status of soils. Thus, it is necessary to have information on availability of major of the area (Mahesh Kumar *et al.* 2011).Soil fertility must be periodically estimated because there is continuous removal of macro nutrients by the crop intensively grown in every crop season. Due to continuous cropping system for periods without adequate supply of additional amounts of nutrients, there is every possibility of deficiencies of essential nutrients in due course of time. For this reason, recent interest in evaluating the fertility status for maintaining soil quality of our soil resources has been stimulated by increasing awareness that the soil is critically important component of earths biosphere, functioning not only in the production of food and fiber but also in the maintenance of local, regional and worldwide environmental quality (Dadhwal *et al.* 2011).Therefore, a comprehensive study was undertaken to know the fertility status of soils of Ambajogai Tahsil of Beed district.

II. MATERIALS AND METHODS

Description of study area: The study area belongs to Ambajogai Tahsil of Beed district is located between 18^0 28' to 19^0 28' North altitude and 74^0 54' to 76^0 57' East latitude. The geographical area of the district is 10615.3 sq. km and it is 3.44 per cent of Maharashtra state. The annual rainfall of this district is in between 458 mm and 814 mm. The maximum and minimum temperature of this district is 40.40^0 C and 17.68^0 C, respectively. The elevation is 530 m from mean sea level. Beed is located on the Deccan Plateau of south central Maharashtra, on the banks of `Bendsura` a sub-tributary of Godavari River. It is situated in the ranges of Balaghat.Under the study area soils are developed from basaltic and metamorphic rocks of varying geological age and also on alluvium derived from such rocks. These soils are scientifically known as "Mixed Montmorillonitic Hyperthermic Typic Chromostert".The study area comes under zone of assured rainfall zone where tropical climatic conditions often exists (Hot Dry Subhumid Agro ecological Region).

Collection of soil samples: In order to studies on assessing nutrient index and fertility status of Vertisol, Inceptisol and Entisol from different villages of Ambajogai Tahsil of Beed District, one hundred and forty, representative surface (0-20 cm) soil samples were collected, ground and passed through <2 mm sieve and stored in properly labeled plastic bags and characterized for physicochemical properties of soil. The soil pH, EC, Organic Carbon, available K, Exchangeable Ca and Mg were estimated by the standard procedures as described by Jackson (1973). The available N was analyzed by using alkaline potassium permanganate (Subbiah and Asija, 1956). Available sulphur was determined by using 0.15% $CaCl_2$ solution(Williams and Steinberg, 1969). The soil nutrient index was calculated according to the procedure given by Parker (1951). The whole data was subjected to statistical analysis by the method described by Panse and Sukhatme (1985).

III. RESULT AND DISSCUSSION

Chemical properties

The results of study presented in Table (1) indicated that all the soil samples from Ambajogai Tahsil were moderately alkaline in soil reaction (100 %) and within safe limit of electrical conductivity (100 %). The pH value of Vertisols, Inceptisols and Entisols varied from 6.99 to 8.89, 7.11 to 8.77 and 7.01 to 8.60 respectively, which indicated that these soils are neutral to alkaline in reaction, whereas EC of soil were ranged from 0.100 to 0.652, 0.104 to 0.556 and 0.105 to 0.370 dSm^{-1} respectively, which were categorized as normal. It may be due to formation of these soils from basaltic parent material rich in basic cations. Similar findings were reported by Jibhakate *et al*. (2009). The organic carbon in Vertisols, Inceptisols and Entisols ranged 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}. The organic carbon ranges from low to high in different orders. It indicates that majority of these soils were low to moderately high in organic carbon content. This might be due to increased rate of decomposition of organic matter as concluded by Rashmi *et al*. (2009). The $CaCO_3$ of Vertisols, Inceptisols and Entisols varied from 35 to 154, 36 to 148 and 38 to 114 g kg^{-1} with a mean value 95.50, 92.90, 80.80 g kg^{-1}, respectively. The majority of soils were categorized as calcareous in nature.The available N in Vertisols, Inceptisols and Entisols ranged from 97.91 to 487.06, 104.57 to 529.08 and 102.64 to 607.13 kg ha^{-1} with an average of 183.11, 176.18, 186.90 kg ha^{-1}, respectively. The N content in above order varied from very low to high. Maximum soil samples categorized as low nitrogen content. It may be due low organic matter content of soil (Vineetha and Malewar, 2009) as well as rapid loss of applied N in soil (Tur *et al*., 2008). The available P in Vertisols, Inceptisols and Entisols were ranged from 1.14 to 21.62, 1.03 to 21.47 and 1.65 to 26.08 kg ha^{-1} with a mean value 7.44, 7.06, 6.86 kg ha^{-1}, respecively. The majority of soil samples were categorized as low phosphorus content. The available K values of Vertisols, Inceptisols and Entisols varied from 118.7 to 842.6, 127.8 to 716.3 and 132.6 to 835.6 kg ha^{-1} with an average of 455.1, 444.5, 428.8 kg ha^{-1}, respectively. The maximum soils of above order were categorized as high potassium content. As per the findings of Tur *et al*. (2008), the low amount of available P may be due to application of lower doses of P fertilizer, fixation of P on clay minerals or $CaCO_3$ surfaces with the time elapsed between fertilizer application and crop uptake. It may be due low organic matter content of soil (Vineetha and Malewar, 2009) as well as rapid loss of applied N in soil (Tur *et al*., 2008).

Table 1. Range and average value of soil site characteristics

Soil order	pH	EC (dSm^{-1})	O.C. (%)	$CaCO_3$ (%)	Avai. N (kg ha^{-1})	Avai. P_2O_5 (kg ha^{-1})	Avai. K_2O (kgha^{-1})	Ca (cmol $(p^+)kg^{-1}$)	Mg (cmol $(p^+)kg^{-1}$)	Avai. sulphur ($mgkg^{-1}$)
Vertisol	6.99-8.89 (8.20)	0.100-0.652 (0.278)	1.30-19.9 (5.0)	35.0-154 (95.5)	97.91-487.16 (183.11)	1.14-21.62 (17.44)	118.7-842.6 (455.1)	11.5-50.7 (34.9)	7.8-28.6 (18.3)	7.81-77.01 (31.8)
Inceptisol	7.11-8.77 (7.97)	0.104-0.556 (0.234)	1.40-16.0 (4.5)	36.0-148 (92.9)	104.57-529.08 (176.18)	1.03-21.47 (7.06)	127.8-716.3 (444.5)	13.5-48.7 (32.6)	7.6-28.3 (15.7)	3.92-76.31 (30.7)
Entisol	7.01-8.60 (7.90)	0.105-0.370 (0.195)	1.40-11.4 (3.8)	38.0-114 (80.8)	102.64-607.13 (186.90)	1.65-26.08 (6.86)	132.6-835.6 (428.8)	15.3-49.6 (35.33)	7.6-27.8 (17.6)	4.22-53.28 (25.7)

Parenthesis "( )" indicates average mean value

In case of secondary nutrients, the exchangeable Ca in Vertisols, Inceptisols and Entisols were ranged from 11.5 to 50.7, 13.5 to 48.7 and 15.3 to 49.6 cmol (P^+) kg^{-1} with a mean value 34.9, 32.6, 35.33 cmol (P^+) kg^{-1}, respectively. All the soil samples were categorized as high exchangeable Ca content. The exchangeable Mg in Vertisols, Inceptisols and Entisols were ranged from 7.8 to 28.6, 7.6 to 28.3 and 7.6 to 27.8 cmol (P^+) kg^{-1} with an average of 18.3, 15.7, 17.6 cmol (P^+) kg^{-1}, respectively. The exchangeable Mg in three orders ranges from low to high. The available S in Vertisols, Inceptisols and Entisols varied from 7.81 to 77.01, 3.92 to 76.31 and

4.22 to 53.28 mg kg^{-1}, respectively. Almost all the soil sample contains high available S. The available S appears to be depending on the combined action of factors like nature of parent material, rain fall, clay and organic matter content in soil (Mohamed Saqeebulla *et al.*, 2012).

Soil Nutrient Index

As per the NIV developed by the Ramamoorthy and Bajaj (1969) the nutrient index value for soils of Vertisol, Inceptisol and Entisol from different villages of Ambajogai Tahsil of Beed Districtrepresents low fertility status (Table 2). The available N, P and Zn were found low in soils, while high with respect to available K, S and exchangeable Ca, whereas medium for exchangeable Mg. The nutrient index values for N, P and K were 1.09, 1.07 and 2.73 respectively, and for Ca, Mg and S were 3.00, 1.98 and 3.00 respectively. The data compiled on nutrient index value revealed that all the soils collected from surveyed area are rated as low in nitrogen. Thus, soils of this region are expected to respond to the added N fertilizers to the greater magnitude. The lower content of available nitrogen in this region is associated with hot and dry climate complex, low content of organic matter and total N reserve and inturn C: N ratio of immobilized forms of nitrogen. Malewar *et al*. (1998) reported N deficiency in soils of northern Marathwada. The investigated soils, however rated as low in available phosphorous because of 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. On the other hand, most of the soils were rated as higher in available potassium. The high content of available potassium in soils mainly associated with the presence of K rich mineral in Vertisols and associated black soils. However, exchangeable Ca and available S were rated as high fertility index value category, whereas exchangeable Mg was included in medium fertility index value category.

Table 2. Nutrient index value (NIV) of Ambajogai tahsil of Beed district

Sr No.	Nutrient	NIV	Category
1	Available N	1.09	Low
2	Available P	1.07	Low
3	Available K	2.73	High
4	Exchangeable Ca	3.00	High
5	Exchangeable Mg	1.98	Medium
6	Available S	3.00	High

Correlation coefficient

The data on correlation coefficient between physicochemical properties and available nutrients in Vertisol are presented in Table (3). In Vertisol pH did not reach to the level of significance with available N, P, K, exchangeable Mg and available sulphur but with exchangeable Ca, pH showed significant and positive correlation. The EC of Vertisols could not established any correlation with available N, P, K, S, exchangeable Ca and Mg. Organic carbon showed positive relationship with available N, P, K and S, which is evident by 'r' values of 0.532**, 0.421**, 0.360** and 0.277*, respectively. However, the effect of $CaCO_3$ with available N, P, K, exchangeable Ca, Mg and available S did not reach to the level of significance. However in Inceptisol (Table 4), pH of soil was not showed significant correlation with available N, P, K, exchangeable Ca, Mg and available S. This might be due to organic carbon forms soluble complexes with micronutrients which subsequently become available to plants (Shah and Andrabi, 2010). Further, it was indicated that organic carbon showed positive and significant correlation with available N and K, which is indicated by 'r' values of 0.739** and 0.319*, respectively.

Table 3. Correlation between chemical properties and available nutrients in Vertisols

Chemical properties	Avail. N	Avail. P	Avail. K	Ex. Ca	Ex. Mg	Avail. S
pH	**0.096**	**0.191**	**0.017**	**0.283***	**0.211**	**-0.016**
EC	**0.087**	**-0.145**	**0.108**	**0.079**	**0.015**	**0.165**
O.C	**0.532****	**0.421****	**0.360****	**0.060**	**0.162**	**0.277***
$CaCO_3$	**0.222**	**-0.263**	**0.179**	**-0.293**	**-0.150**	**-0.132**

*** Significant at p=0.05 level : - 0.273, ** Significant at p=0.01 level : - 0.354**

Table 4. Correlation between chemical properties and available nutrients in Inceptisol

Chemical properties	Avail. N	Avail. P	Avail. K	Ex. Ca	Ex. Mg	Avail. S
pH	**-0.073**	**0.101**	**0.039**	**0.063**	**0.181**	**-0.181**
EC	**0.015**	**0.206**	**0.163**	**-0.268**	**0.072**	**-0.046**
O.C	**0.739****	**-0.253**	**0.319***	**0.136**	**-0.011**	**0.044**
$CaCO_3$	**-0.143**	**0.014**	**-0.389****	**-0.227**	**0.035**	**-0.285***

*** Significant at p=0.05 level : - 0.273, ** Significant at p=0.01 level : - 0.354**

Table 5. Correlation between chemical properties and available nutrients in Entisols

Chemical properties	Avail. N	Avail. P	Avail. K	Ex. Ca	Ex. Mg	Avail. S
pH	-0.266	-0.295	0.126	0.367*	0.171	-0.057
EC	0.050	0.119	0.242	-0.230	0.227	0.258
O.C	0.183	-0.045	0.539**	-0.055	-0.306*	0.437**
$CaCO_3$	0.070	-0.342*	0.108	-0.212	-0.185	-0.107

*** Significant at p=0.05 level: - 0.325, ** Significant at p=0.01 level : - 0.418**

However, $CaCO_3$of soilwas negatively and significantly correlated with available K and S which is evident by 'r' values of -0.389** and -0.285*, respectively. In Entisol (Table 5), pH was significantly and positively correlated with the exchangeable Ca, pH showed negative and significant correlation. The EC of Entisols did not reach to the level of significance with available nutrients. However, organic carbon in Entisols associated positively and significantly with available K and S, which is evident from 'r' values of 0.539** and 0.437*, respectively. Further, $CaCO_3$ did not show any correlation with any other properties. The whole results indicatedthat increasing contents of organic carbon in soils resulted increases in availability of nutrients indicated by higher 'r' values. At higher pH and $CaCO_3$ the soluble metallic cation precipitates chemically and inturn decrease their availability (Jibhakate *et al*. 2009).

IV. CONCLUSION

Selected soils are classified into Vertisols, Inceptisols and Entisols. Almost soil samples pH was alkaline in nature and EC was in safe limit for the crop growth. The organic carbon status was low to high, $CaCO_3$were calcareous in nature. Low nitrogen, low phosphorus and high potassium were observed in this soil. The exchangeable Ca and available S were in sufficient quantity, while exchangeable Mg ranged from low to high. The organic carbon showed positive and significant correlation with available N, P and K, whereas pH and $CaCO_3$were significantly and negatively correlated with available nutrients. Defining soil fertility are medium and deficienciesaddressing different nutritional status of soil is very important for developing soil fertility status andto recover deficient nutrients level in future time.

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