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Evaluation of Soil Nutrient Index and their Relation with Soil Chemical Properties of Washim Road Farm of Dr.PDKV Akola, Maharashtra, India

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A B S T R A C T

The present study was conducted during the year 2018 and 2019 at Department of Soil Science and Agricultural Chemistry, Dr Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra with an aim to know the macro and micronutrient status of soils of Washim road farm, Dr. PDKV Akola. Grid based (GPS) forty-four (44) surface (0-20 cm depth) soil samples were collected by grid survey method at 200m distance from Washim road farm and analyzed as per standard procedure for judging chemical properties and available nutrient status of soil. The results indicate that all the soils were slightly alkaline to moderately alkaline in reaction and free from soluble salt hazard. Organic carbon content were ranged from 2.34-8.97 g kg^{-1}, soils of Washim road farm was moderately calcareous to calcareous due to presence of $CaCO_3$ in soil. Nutrient index value (NIV) showed moderate for organic carbon, phosphorus and available Sulphur whereas moderately high for $CaCO_3$, very low for available N and very high for available potassium. Among available micronutrients Fe, Zn, Mn showed low nutrient index value (NIV), Cu found to have high nutrient index for Washim road farm. In Washim road farm statistical correlation ship showed significant and positive correlation of organic carbon with ECThe DTPA extractable Fe (r= 0.303*). and Mn (r= 0.321*) showed positive and significant correlation with available N.

Introduction

Soils are inherently heterogeneous in nature, diverse and dynamic system and its properties change in time and space continuously. Heterogeneity in soil properties with depth and across landscapes can be accounted for by several interacting factors that operate with different intensities and at different scales and acting simultaneously. Soil is a medium for plant growth and development that leads to crop productivity. Crop productivity depends on many factors and soil fertility is major branch amongst all. Soil fertility has direct relation with crop yields, provided other factors are in optimum level. Soil fertility must be periodically estimated as there is continuous removal of macro and micronutrients by crop intensively grown in every crop season. The availability of soil nutrients for plant growth and yield production is a function of different parameters, including

soil pH, soil organic matter and texture, and soil biological activities. Hence, determination of such parameters is important for evaluating nutrient behavior in the soil and for suggesting appropriate methods of enhancing nutrient availability to plant. (Shazia *et al.,* 2017)

All researches in soil fertility have one common goal that is to assess nutrient supplying capacity of the soil, deficiencies of nutrient if any and to supply nutrient based on crop needs. Thus, in the game of crop production, there are three dependent and yet interdependent players the soil, the plant and fertilizers, each one of them key players (Goswami, 1999).The challenge during the next millennium is to achieve and sustain growth rates high enough to feed the swelling population without degrading the environment (NAAS, 1997).The fertility status of soils can be evaluated by using nutrient index method and fertility indicators. Ravikumar and Somashekar (2013) evaluated the nutrient index of soils using organic carbon, available P and available K concentrations as a measure of soil fertility in Varahi River basin, India. The aim of this contribution is to describe spatial distribution of basic soil properties and vulnerability coefficient on the Washim road farm and to analyse statistical relationship between soil properties.

Materials and Methods

The Washim road farm lies between longitude 76°59'42.7" to 76°59'34"E, Latitude 20°40'42" to 20°40'58"N. Total 44 surface soil samples with (0-20 cm depth) from cultivated area of the washim road farm Dr. PDKV, Akola were collected using Global Positioning System (GPS) at grid interval of 200 m. The grid wise sample were collected, the sample were labeled, air dried and sieve through 2 mm sieve for analysis of soil fertility parameter.

Soil pH and electrical conductivity at 1:2.5 soil water suspensions (Jackson 1973). Organic carbon was measured by Chromic acid wet digestion method (Walkley and Black 1934). And $CaCO_3$ was determined by rapid titration method (Piper 1966). Available N was determined by method described by Subbiah and Asija (1956), the available P was colorimetrically as per Jackson (1973), the available K was estimated by extracting the soil with 1 N NH_4OAC (pH 7.0) by using flame photometer (Jackson, 1973) and Available Sulphur was estimated by 0.15% $CaCl_2$extractable method (Piper, 1966). While the available micronutrient cation (Fe, Mn, Zn and Cu) were extracted by DTPA-$CaCl_2$extract (Lindasay and Norvell,1978).The soil nutrient index was calculated according to the procedure given by Ramamoorthy and Bajaj (1969).

Results and Discussion

The results presented in (Table 1) revealed that the pH of the soils of Washim road farm, were ranged from 7.50 to 8.60 indicating slightly to moderately alkaline in reaction. The alkaline reaction of soil is probably due to presence of sufficient free lime content in these soils (Jibhkate *et al.,* 2009).The EC ranged from 0.13 to 0.38 dSm⁻ and suitable for healthy plant growth. (Padole and Mahajan, 2003) The EC value <1.0 indicate that these soils are free from hazard of soluble salts as prescribed by Richards (1954).

The soils were low to moderately high in organic carbon content (2.34 to 8.97 g kg^{-1}).. The low content of organic carbon might be due to slow rate of decomposition and continuous utilization by plants for the uptake of nutrients. Similar results were reported by Patil *et al.,* (2008) in the soils of Agriculture college farm, Pune.

The free lime content ranged from 4.25 to 10.0 %. It indicates that these soils are moderately calcareous (18%) to calcareous (82%) in nature.

The data presented in (Table 1) revealed that the available nitrogen in Washim road farm ranged from 100.35 - 175.61 kg ha^{-1}. Similar observations were also recorded by Dhale and Prasad (2009). As per rating standard, soils of Washim farm low in available nitrogen content. The soils thus need judicious application of both organic manure and nitrogenous fertilizers to meet the N requirement of crops grown in them.The available phosphorus ranged from 13.25 to 22.4 kg ha^{-1} in Washim road farm.The variation in the availability of phosphorus might be due to variation in CaCO$_3$ content of the soil, different soil properties and agronomic practices. The result closely point by Bharambe *et al.,* 2001.The available potassium for Washim road farm soil ranged from 340.14 to 539.05 kg ha^{-1}. As per ratings, soils containing available potassium more than 300 kg ha^{-1} categorized as very high in available potassium content. The data on the basis of available potassium content indicates that the soils have no problem of K deficiency. Similar results were also reported by Kashikar (1983)for black soils.Sulphur ranged from 7.58 to 16.4 mg kg^{-1}. As per ratings, soils containing available Sulphur more than 20 mg kg^{-1} categorized as very high in available Sulphur content. Low available Sulphur in these soils may be due to the less supply of Sulphur containing fertilizers. The results closely confirmative with (Wagh *et al.,* 2008)

The DTPA extractable Fe content in soils of ranged between 2.05 to 5.96 mg kg^{-1}, considering critical limit for DTPA –Fe 2.5-4.5 mg kg^{-1} as given by Katyal and Rattan(2003) these soils are found to be sufficient in available Fe content it is due to the increased in CaCO$_3$ and clay content in the

soils (Jibhkate *et al.,*2009).Magnitude of available manganese content in soils ranged from 0.82 to 4.47 mg kg^{-1} indicates very low to medium status. The available zinc extracted by DTPA varied from 0.12 to 0.88 mg kg^{-1} for soils under study are categorized as a medium in available zinc status. Similar observation was recorded by Gajbhiye *et al.,* (1993).

The available copper extracted by DTPA ranged between 0.73 to 3.12 mg kg^{-1}. Considering critical limit of 0.2 mg kg^{-1} as suggested by Katyal and Rattan (2003), these soils are categorized as high in available copper content. Similar results were reported by Jibhkate *et al.,* (2009).

Nutrient Index Value

As per the NIV developed by Ramamoorthy and Bajaj (1969) the nutrient index values were calculated for Washim road farm of the University, to know the fertility status of these soils (Table 2). The soil nutrient index value of Washim road farm calculated for organic carbon content was 1.73 with moderate category. Nutrient index value calculated for calcium carbonate was 1.90 with moderately high category. As regards the available nitrogen content nutrient index value was 0.75 with very low category.

Phosphorus the major important nutrient in terms of plant growth was available in moderate category with NIV 1.57. nutrient index value for potassium shows very high with 3.0 NIV.

As per the NIV developed by Ramamoorthy and Bajaj (1969) the nutrient index values were calculated for Washim road farm of the University, to know the fertility status of these soils (Table 2). The soils of Washim road farm showed low nutrient index value (NIV) for available Zn, Fe, Mn i.e. 1.04, 1.12 and 1.35, respectively.

Table.1 Status of Nutrient for Washim road farm of the University

No. of sample analysed	Parameters	Range	Mean	Ratings					
				VL	L	M	Mod. H	H	VH
44	pH	7.5-8.6	7.95	-	-	-	-	-	-
	EC (dSm^{-1})	0.13 - 0.38	0.25	-	-	-	-	-	-
	OC (g kg^{-1})	2.34- 8.97	5.88	0	3 (7%)	17 (39%)	23 (52%)	1 (2%)	0
	CaCO$_3$	4.25- 10.0	6.98	0	0	8 (18%)	36 (82%)	0	0
	N (kg ha^{-1})	100.35- 175.61	139.72	22 (50%)	22 (50%)	0	0	0	0
	P (kg ha^{-1})	13.25-22.4	18.01	0	2 (5%)	33 (75%)	9 (20%)	0	0
	K (kg ha^{-1})	340.14- 539.05	420.77	0	0	0	0	0	44 (100%)
	S (mg kg^{-1})	7.58- 16.4	11.51	0	12 (27%)	28 (64%)	4 (9%)	0	0
	Fe (mg kg^{-1})	2.05- 5.96	4.06	4 (9%)	25 (57%)	15 (34%)	0	0	0
	Mn (mg kg^{-1})	0.- 4.47	2.63	7 (16%)	8 (18%)	20 (46%)	9 (20%)	0	0
	Zn (mg kg^{-1})	0.12- 0.88	0.46	11 (25%)	18 (41%)	15 (34%)	0	0	0
	Cu (mg kg^{-1})	0.73- 3.12	1.78	0	0	0	1(2%)	6 (14%)	37 (84%)

Table.2 Status of Nutrient Index Value (NIV) for Washim road farm

Elements	NIV	Category
OC (g kg^{-1})	1.73	Moderate
CaCO$_3$ (%)	1.90	Mod. High
Avail. N (kg ha^{-1})	0.75	Very Low
Avail. P (kg ha^{-1})	1.57	Moderate
Avail. K (kg ha^{-1})	3	Very High
Avail. S (mg kg^{-1})	1.40	Moderate
Avail. Fe (mg kg-1)	1.12	Low
Avail. Mn (mg kg-1)	1.35	Low
Avail. Zn (mg kg-1)	1.04	Low
Avail. Cu (mg kg-1)	2.73	High

Table. 3. Relationship between soil chemical properties with available macro and micronutrients in Washim road farm

	pH	EC	OC	CaCO3	Avail. N	Avail. P	Avail. K	Avail. S	Fe	Mn	Zn	Cu
pH	1											
EC	-0.019	1										
OC	-0.131	**0.308***	1									
CaCO3	-0.219	-0.118	-0.073	1								
Avail. N	0.137	-0.009	-0.053	-0.031	1							
Avail. P	0.293	0.169	-0.239	-0.252	0.29	1						
Avail. K	-0.142	-0.224	-0.012	-0.092	-0.006	0.113	1					
Avail. S	0.062	0.062	0.164	-0.146	0.143	**0.420****	0.148	1				
Fe	0.135	0.244	-0.049	0.071	**0.303***	0.152	-0.266	0.111	1			
Mn	0.068	0.276	0.055	-0.07	**0.321***	0.284	-0.295	0.084	0.186	1		
Zn	0.138	-0.06	0.201	0.112	-0.152	-0.114	0.099	-0.04	0.142	**-0.320***	1	
Cu	-0.151	-0.042	0.009	-0.088	-0.146	0.016	-0.172	-0.253	0.107	0.122	-0.18	1

*Significant at 5% level of significance
** Significant at 1% level of significance

This soil was in category of very high nutrient index value (NIV) for available Cu i.e. 2.73. The details of soil nutrient index of micronutrients for Washim road farm of the University presented in the Table 2.

Correlation

The overall correlation studies between chemical properties and available macro and micronutrients for Washim road farm was analysed and presented below.

In Washim road farm statistical correlation showed significant and positive correlation of organic carbon with EC which is evident by 'r' values of 0.308*. The DTPA extractable Fe (r= 0.303*). and Mn (r= 0.321*) showed positive and significant correlation with available N. Similarly, available zinc showed significantly but negative correlation with Mn of soil. (r= -0.320*). It was observed that available S showed positive and significant relation with available P (r=0.420*) in the soil. It can be concluded that, the soils of Washim road farm are slightly alkaline to moderately alkaline in soil reaction, safe in electrical conductivity, low to moderate high in organic carbon content and moderately calcareous to calcareous in nature. According to the concept of soil nutrient index soils are very low in the available N, medium in P, high in K and medium in S content. Nutrient index for micronutrients are low in available Fe, Mn, Zn and high in available Cu content.

References

Bharambe, P. R., Kadam S. G., Shinde S.D., and Shelke D.K., 2001. Characterization of soils Majalgaon canal command area (Jayakwadi project stage II) *J. Indian Soc. Soil Sci.*47 (4) : 749-754.

Dhale, S.A. and Jagdish Prasad. 2009. Characterization and classification of sweet orange growing soils of Jalna District, Maharashtra, *Journal of the Indian Society of Soil Science, Vol.* 57, No. 1, PP 11-17.

Gajbhiye, K.S., S.T. Gaikwad, J.L. Sehgal and Ratna Gupta. 1993. Micronutrient status and deficiency delineation in Vertisols and their intergrades – A case study of Saongi Watershed. *Agropedology*, 3.

Goswami NN. 1999. Raychaudhuri memorial lecture. Priorities of soil fertility and fertilizer use research in India. *Journal of the Indian* society *of soil science*. 1999; 847(4):649-660.

Jackson, M.L. 1973. Soil chemical analysis, prentice Hall of India. Pvt. Ltd., New Delhi, p. 498.

Jibhakate, S.B., M.M. Raut, S.N. Bhende and V.K. Kharche. 2009. Micronutrient status of soils of katol tahasil in Nagpur District and their relationship with some soil properties. *J. Soils and crops 19(*1) 143-146.

Kashikar, C.G. 1983. Characterization of clay fraction from black soils. M.Sc. (Agri.) Thesis (Unpub). PKV, Akola.

Katyal. J.C. and Rattan R.K. 2003. Secondary and micronutrients research gaps and future needs. *Fertilizers news vol.* 48 (4), pp 9-14 & 17-20 (10 pages).

Lindsay, W.L. and W.A. Norvell, 1978. Development of a DTPA soil test for zinc, iron, manganese and copper, *Soil Sci. Soc. America J.*, 42: 421-428.

NAAS. 1997. Crop response and nutrient ratio. NAAS Policy Paper No. 42 (R. Prasad and P.S. Pathak, Eds), National Academy of Agricultural Sciences, New Delhi.

Padole VR. and Mahajan SB. 2003. Status and release behavior of potassium in Swell-Shrink soils of Vidarbha, Maharashtra, *J. Maharashtra agric. Univ,* 2003; 28(1):3-7.

Piper, 1966. Soil and Plant analysis, 135-136,

Hans Publishers Bombay.

Ramamoorthy B, Bajaj JC. 1969. Available N, P and K status of Indian soils. Fertilizer News. 14:24-26.

Ravikumar P., Somashekar R.K. 2013. Evaluation of nutrient index using organic carbon, available P and available K concentrations as a measure of soil fertility in Varahi River basin, India. *Proceedings of the International Academy of Ecology and Environmental Sciences*, 2013, 3(4): 330-343.

Shazia Ramzan, Mushtaq A. Wani. and Auyoub Bhat M., 2017. Assessment of Spatial Variability of Soil Fertility Parameters Using Geospatial Techniques in Temperate Himalayas. *International Journal of Geosciences,* 2017, 8, 1251-1263.

Walkley, A.J. and Black I.A., 1934. Estimation of soil organic carbon by the chromic acid titration method. Soil Sci., 37: 29-38.

Wagh, S.P., Ommala D. Kuchanwar and Renu V. Haware. 2008. Nutritional Status of Acid lime orchards in Akola District. *PKV Res. J. Vol*. 32 (2).