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Fertility Status of Different Vineyards in Nashik District, Maharashtra

Rupali B. Patil

Department of Chemistry, K.S.K.W. Cidco College, Nasik, [Affiliated to Savitribai Phule Pune University, Pune Maharashtra, India
Corresponding Author Email: *rupali25878[at]gmail.com*

Abstract: ***Fertility status of the soil is an important aspect in grape growing soils. It governs the Nutrients present in the soils and control the yields of crops. Nashik District is well known as a grape city was selected for the study. Fifteen representative villages were chosen and different number of surface soil samples (0-20cm) collected and analyzed for physico-chemical properties and available N, P, K, status. Results revealed that texture of the soils varied from clay loam to clay. Soil samples were found high in organic carbon. The soils were low to moderate in available nitrogen content, very low in available phosphorous content while, the available potassium indicates very high content. Significant positive correlations were found to exist between organic carbon and available N, P, K status of soil under study.***

Keywords: Vineyard Soils; Physicochemical analysis; Macronutrient

1. Introduction

Soil characterization in relation to evaluation of fertility status of the vineyard soils is valuable in context of sustainable agricultural production. Nitrogen, Phosphorous and Potassium are important soil elements that control its fertility and yields of the crops. The physicochemical analysis of soil is very useful in order to plan fertilization and to know the residues of fertilizers in relation to the crop, tillage and climate. An analysis can highlight shortages and help to understanding of the cause of an abnormal growth.

Therefore, the present study was undertaken to know the nutrient status of soils and an attempt was also made to correlate different physicochemical parameters.

2. Materials & Methods

Three major grape growing tahsil from Nashik district namely Niphad, Dindori and Nashik were selected as a study area. Grape farm of five progressive farmers were selected from each tahsil for proposed study. Total fifteen soil samples were analysed.
Soil samples were collected from each village and composite soil samples (0-20cm) were prepared. Codes were given as A to O for fifteen soil samples. Soil samples were air dried, processed to pass through 2mm sieve and analysed for pH, E.C., Water Holding Capacity (W.H.C.), Calcium carbonate and soil texture as per standard methods (Jackson, 1973). Organic carbon was estimated by the method of Walkey and Black (1935), available Nitrogen (Alkaline Per magnate method), Phosphorous (Olsen's Method), Potassium (Neutral ammonium acetate extractable).

The simple correlation analysis of data was computed in relation to available nutrient contents with physico-chemical properties of the soils under study.

3. Result & Discussions

Soil pH and Electrical Conductivity
Data presented in table 1 show that soil pH varies from 7.05 to 7.83. It is interesting to observe narrow range of variation in pH which can be attributed to high buffering capacity of soils. (Shinde,1997). The electrical conductivity of the soils varied from 0.10 to 1.33 dsm-1 on the basis of limits suggested by Maral, (2010) for judging salt problem of soils, most of the samples were found normal (EC < 1.0 dsm-1). The normal electrical conductivity may be ascribed to leaching of salts to lower horizons.

Soil Texture and Water Holding Capacity
It was observed that the majority of the soils are in the clay and clay loam category with good water holding capacity. Clay loam soil increases the yield of vineyards as it has good water and nutrient holding capacity Yogeeshappa (2007). Critical examination of data from table 1 reveals that calcium carbonate content in the soil varies from 6.2 -10.2%. All the soil samples contain higher percentage of calcium carbonate reflecting their high calcareous nature, may be due to the alkaline pH of the soil samples, which have tendency of precipitation of $CaCO_3$ during irrigation (Deshmukh,2012).

Organic Carbon
Organic carbon of soil samples varied as 0.50 to 1.20 %. Most of the soil samples show higher percentage of organic matter reflects good fertility and productivity Brady (2008) mentioned that, the higher soil organic matter occurred more commonly in cooler climates.

Available Nitrogen
Available Nitrogen status varied from 94.08 to 314.85 Kg / ha with mean value. Low values of available nitrogen might be due to higher rate of mineralization and loss of nitrogen in the form of ammonia as the soils are calcareous.

Available Phosphorous
The available phosphorous content varied from 0.56 to 1.74 Kg/ha with mean value 112.98 Very low status of available phosphorous was found nearly in all the soils from the study area. According to Mcauliffe et al. (1948), phosphate ions are very strongly absorbed by the soil; the result is very low concentration of available phosphorous.

Available Potassium
Status of available potassium in the soils ranged between

123.2 to 515.2 Kg/ ha with an average of 281.86 Kg/ha. Most of the soil samples have higher content of available potassium can be correlated with the use of potassium fertilizers like KCl and K_2SO_4

Data Analysis

To find the relationships between the physicochemical parameters of soil samples collected from different grape farms from study area, the correlation coefficient "r" was calculated by using following formula used by Pearson (1957)

$$r = \frac{n \sum xy - (\sum x)(\sum y)}{\sqrt{n(\sum x^2) - (\sum x^2)}\sqrt{n(\sum y^2) - (\sum y^2)}}$$

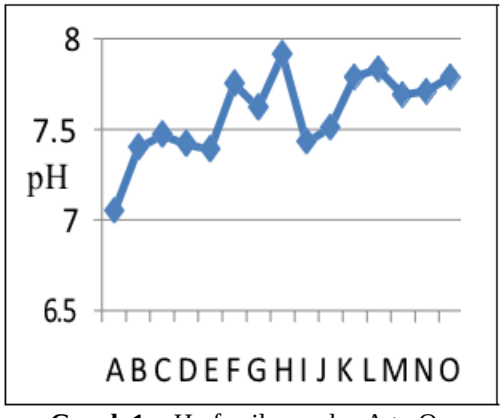
Where n is the number of pairs of data (x, y).

Table 1: Physicochemical parameters of soil samples

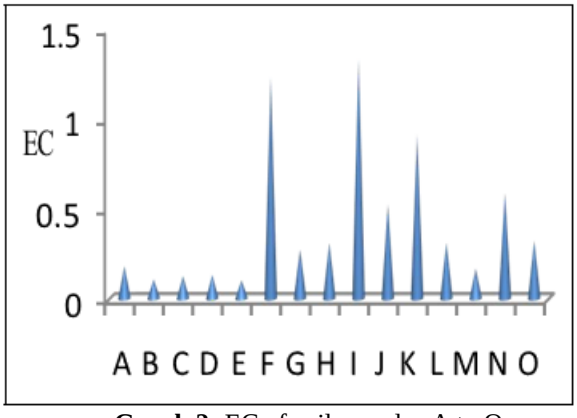
Soil sample code	Soil texture	pH	E. C. (mmh os/cm)	WHC	CaCO3	O.C.	N	P	K	% sand	% clay	% silt
A	Clay loam	7.05	0.182	66.3	8.5	1.05	115.2	1.34	201.6	22.72	36.36	40.9
B	Clay loam	7.40	0.108	66.9	8.4	1.17	180	0.94	459.2	29.41	38.23	32.35
C	Clay loam	7.47	0.127	64.63	6.5	0.59	213	1.27	347.2	24.00	34.66	41.33
D	Clay	7.42	0.133	78.87	6.9	0.97	193.5	1.38	515.2	26.66	53..33	20.00
E	Clay	7.39	0.104	76.98	6.8	0.89	226.5	1.68	140	16.39	52.45	31.14
F	Clay	7.75	1.23	72.46	9.2	0.78	142.5	1.5	179.2	22.53	46.47	30.98
G	Loam	7.62	0.275	71.33	8.1	1.14	106.6	1.18	224	32.78	26.22	40.98
H	Clay loam	7.91	0.311	63.2	10.2	0.95	166.2	1.03	123.2	32.83	32.83	34.32
I	Sandy Clay loam	7.43	1.33	58.61	9.1	0.55	97.18	0.87	246.4	53.33	26.66	20.00
J	Loam	7.51	0.523	63.91	7.4	1.09	112	1.74	291.2	40.00	29.33	30.66
K	Clay loam	7.79	0.909	60.41	6.2	1.2	285.2	0.62	476	42.30	35.89	23.79
L	Sandy Clay loam	7.83	0.311	58.89	9.5	0.62	95	1.59	190.4	54.16	20.83	25.00
M	Silt Clay loam	7.69	0.168	59.53	9.3	0.5	314.9	0.56	268.8	18.91	29.72	51.35
N	Clay loam	7.71	0.587	64.69	6.4	1.01	262.0	0.78	151.2	26.66	38.66	34.66
O	Silt Clay loam	7.79	0.324	60.21	7.6	0.55	109.7	0.71	414.4	20	30	50.00
Mean		7.58	0.44	65.79	8	0.87	174.6	1.14	281.8	30.84	33.55	33.83
Min		7.05	0.10	58.61	6.2	0.5	95	0.56	123.2	16.39	20.83	20.00
Max		7.91	1.33	78.87	10.2	1.2	314.9	1.74	515.2	54.16	52.45	51.35

(**E.C**: Electrical Conductivity, **W.H.C**: Water Holding Capacity, **$CaCO_3$**: Lime Content, **O. C**: Organic Carbon, **N**: Available nitrogen**, P**: Available Phosphorous, **K**: Available Potassium)

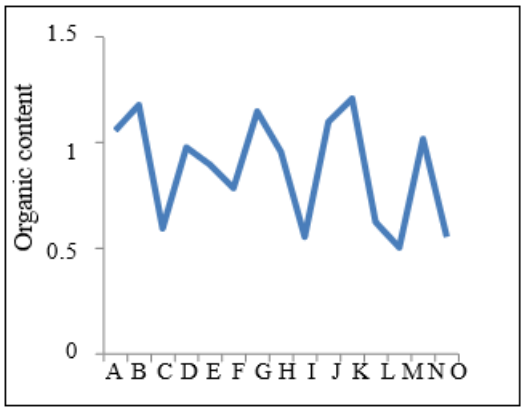
The correlations between soil physicochemical parameters are shown in table 2. There were significant and positive correlation between found in between water holding capacity and calcium carbonate ($r = 0.951$, $p < 0.01$) r value indicates very high correlation between these parameters, with organic carbon ($r = 0.688$, $p < 0.01$), organic matter ($r = 0.884$, $p< 0.01$) shows high correlation, with NPK also. It was positively and significantly correlated ($r =0.818$, $p < 0.01$), ($r =0.892$, $p < 0.01$), ($r =0.758$, $p < 0.01$) respectively. WHC shows significant positive correlation with % sand ($r =0.733$, $p < 0.01$), % clay ($r = 0.938$, $p < 0.01$) and % silt ($r = 0.781$, $p < 0.01$) also. It was interesting to note that, the correlation coefficient value between % clay and water holding capacity indicates very strong and highly significant correlation between these two parameters. As discussed earlier clay soil composed of very fine particles due to which it has higher water holding capacity. Significant and positive correlation of WHC with almost all other parameters except pH and E.C. reflects importance of this parameter in soil. The significant and positive correlation is also found among major nutrients NPK. The organic matter and NPK also show significant and positive correlation proved that, organic matter plays an important role in availability of nutrients. While there was not significant correlation can be found in between pH and E.C



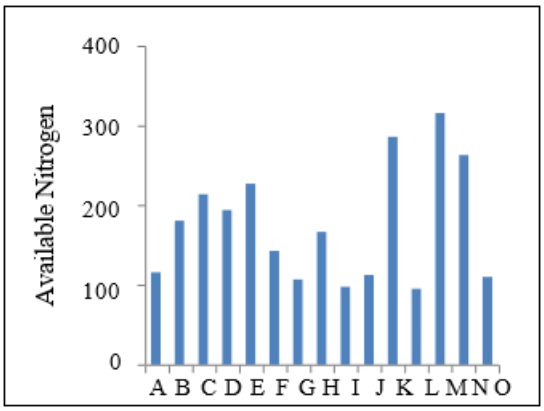
Graph 1: pH of soil samples A to O



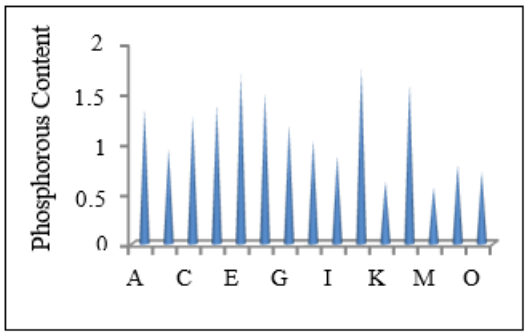
Graph 2: EC of soil samples A to O



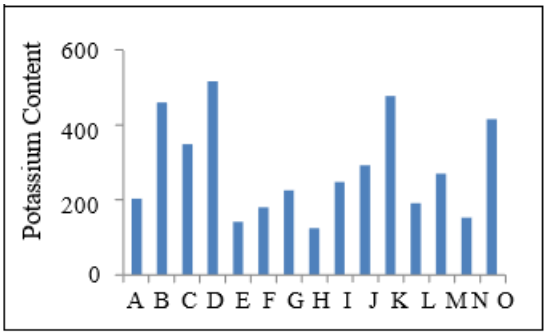
Graph 3: Organic content of soil samples A to O



Graph 4: Available Nitrogen of soil samples A to O



Graph 5: Phosphorous content of soil samples A to O



Graph 6: Potassium content of soil samples A to O

Table 2: Pearson Correlation between Physicochemical Parameters

		PH	E.C. (mmhos/cm)	W.H. C.	CaCO3	O. C.	Organic matter	N	P	K	%sand	%clay	% silt
E.C. (mmhos/ cm)	(r)	0.247											
	P value	0.374 (NS)											
Water holding capacity	(r)	-0.373	-0.252										
	P value	0.172 (NS)	0.366 (NS)										
Calcium carbonate	t (r)	0.217	0.13	0.951**									
	P value	0.438 (NS)	0.644 (NS)	0.0001									
Organic carbon	(r)	-0.207	-0.1	.688**	.616**								
	P value	0.459 (NS)	0.724 (NS)	0.0001	0.001								
Organic matter	(r)	-0.209	-0.102	.884**	.820**	.711**							
	P value	0.455 (NS)	0.717 (NS)	0.0001	0.0001	0.0001							
Nitrogen	(r)	0.15	-0.157	.818**	.742**	.618**	.765**						
	P value	0.593 (NS)	0.577 (NS)	0.0001	0.0001	0.002	0.0001						
Phosphorous	(r)	-0.328	-0.147	.892**	.828**	.660**	.802**	.558**					
	P value	0.233 (NS)	0.601 (NS)	0.0001	0.0001	0.001	0.0001	0.007					
Potassium	(r)	-0.113	-0.125	.758**	.660**	.606**	.721**	.680**	.550**				
	P value	0.689 (NS)	0.656 (NS)	0.0001	0.001	0.004	0.0001	0.001	0.01				
%sand	(r)	0.215	0.458	.733**	.808**	.576**	.706**	.478*	.680**	.600**			
	P value	0.442 (NS)	0.086 (NS)	0.0001	0.0001	0.008	0.001	0.033	0.001	0.005			
%clay	(r)	-0.255	0.018	**.938****	**.802****	**.714****	**.822****	**.786****	**.771****	**.618****	.521*		
	P value	0.38 (NS)	0.952 (NS)	0.0001	0.0001	0.001	0.0001	0.0001	0.0001	0.006	0.027		
%silt	(r)	0.058	-0.449	**.781****	**.792****	**.493***	**.597****	**.646****	**.524***	**.506***	**0.374**	**.734****	1
	P value	0.838 (NS)	0.093 (NS)	0.0001	0.0001	0.038	0.009	0.004	0.026	0.032	0.126	0.001	
***. Correlation is significant at the 0.01 level (2-tailed).*													
** Correlation is significant at the 0.05 level (2-tailed).*													

All bold type results are having significant correlation(*) and highly significant correlation (**)
ha^{-1} indicates very high content 543.39.

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4. Conclusions

Most of the soil belongs to clay and clay loam in texture with good water holding capacity. The pH of soil samples was neutral to slightly alkaline ranges from 7.05 to 7.91. The E.C. of the soil was normal ranging from 0.10 to 1.33 mmhos cm^{-1} found suitable for crop growth. High percentage of calcium carbonate *i.e.* lime content in all soil samples ranges in between 6.2-10.2 reflects high calcareous nature of soil in study area. Percentage of organic matter content of soil samples are moderate to very high found in between 0.86 to 2.06 %. The soils were low to moderate in available nitrogen content ranged from 94.08 to 314.85 kg ha^{-1}. The available phosphorus content in the soils ranged from 0.56 to 1.74 kg ha-1 was very low in its content. The available potassium content of the soil ranged from 123.2 to 515.2 kg soils are efficient in K for crop production. The correlations between soil property values were analyzed using the Pearson's correlation coefficient. Water holding capacity shows significant and positive correlation of with almost all other parameters except p^H and E.C. The significant and positive correlation is also found among major nutrients NPK. Organic matter and NPK also shows significant and positive correlation.

There is a need to develop field analysis techniques for the analysis of some important soil quality parameters. With the knowledge and experience gained during this study practical field analysis techniques for determination of different chemical characteristics can be developed in the future so that, the soil analysis could be done easily by the farmers in the field. This will be highly useful for them to get better quality produce with high yield. Farmers should be encouraged for soil analysis that will help in soil conservation and better environmental protection.

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