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EVALUATION OF SOIL FERTILITY STATUS FROM TEDIA VILLAGE, ARAJI LINE BLOCK, VARANASI DISTRICT, UTTAR PRADESH, INDIA

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Abstract: *Soil fertility evaluation of an area is an important aspect in context of sustainable agriculture production. The macro nutrients govern the fertility of soils and control the growth and yields of crops.The aim of this study was to evaluate soil fertility status from Tedia village, Varanasi district, U.P. 35 surface soil (0-15 cm) samples were analyzed for various soil fertility parameters like pH, EC, organic matter, available N, P and K. Bulk density, Particle density and Porosity by standard procedure. The pH ranged from 5.9 to 7.6 reflecting slightly acidic to slightly alkaline nature of soils. EC ranges between 0.05 to 0.77dSm^{-1}.Organic carbon ranges from 0.32 to 0.77%. 51.4% and 45.7% samples showing low and medium organic carbon status respectively. 100% samples are in low status in available N and most of the soil samples have medium status in P and K, 14.2% soil samples are high in Phosphorous improper agriculture practices, intensive farming, monoculture type of cropping pattern and over irrigation are responsible for degradation of soil fertility from the area. Bulk density ranges from 1.32 to 1.42Mg m^{-3}, Particle density ranges from 2.25 to 2.42Mg m^{-3} and Porosity ranges from 37.8 to 59.4%. To overcome the adverse effect, complementary use of bio-fertilizers, organic manures in suitable combination of chemical fertilizers were suggested. Awareness camps, rallies, and training program can be arranged for farmers regarding the benefits of balanced use of chemical fertilizers and use of organic agriculture in crop production in improving soil fertility and nutrition status.*

Key words: *Soil fertility, organic matter, available nutrients & physicochemical properties etc.*

1. Introduction: Soil plays a major role in determining the sustainable productivity of an agro-ecosystem. The sustainable productivity of a soil mainly depends upon its ability to supply essential nutrients to the growing plants. Uptake of micronutrients is affected by the major nutrients due to either negative or positive interaction [1]. The degradation of soil has started occurring both due to natural and human induced factors which in turn affecting the productivity. As human population continue to increase, human disturbance of the earth's ecosystem to produce food and fiber will place greater demand on soil to supply essential nutrients. The soils native ability to supply sufficient nutrients has decreased with higher plant productivity level associated with increased human demand for food. Therefore one of the greatest challenges today is to develop and implement soil, crop and nutrients management technologies that enhance the plant productivity and quality of soil, water and air.

The evaluation of soil fertility includes the measurement of available plant nutrients and estimation of capacity of soil to maintain a continuous supply of plant nutrients for a crop. The availability of nutrients depends on various factors such as type of soil, nature of irrigation facilities, pH and organic matter content. According to [2], soil quality degradation process with reference to productivity or fertility encompasses physical chemical and biological degradation process. This is pre-requisite for determining appropriate conservation activities in monitoring our natural resource base. The present study was undertaken to know the macro

nutrient status of soils of Tedia village and an attempt was also made to correlate macro nutrients content of the soils with other soil properties. Present investigation was useful in judging the deficiency of various element and thereby use of fertilizers depending on their status. The present study was conducted for covering study of the status of macronutrient and their correlation with physicochemical properties in the soils of Tedia village Arajiline block, district Varanasi (U.P.).

2. Materials and Methods

2.1. Study Area: Tedia village situated in southern end of Varanasi district in Arajiline block. Co-ordinates of the location is 25˚12' N to 82˚49' E and altitude is 82 m. Most of the land of this village is cultivable. Soils of this village are mostly sandy loam and light textured. Farmers of this village are progressive and creative. Farmers of this village are grower of all type of crops like cereals, pulses, vegetable and flower also. Farmers become aware about their soil health.

2.2. Soil Sampling: Selected 35 surface soil samples (0-15 cm) were collected in butter paper bag as per the standard procedure. Quartering technique was used for preparation of soil sample. The samples were dried in air and passed through 2 mm sieve and stored in cloth bag. The soil pH and EC were determined from the saturation extract (1:2.5 soil water ratio) of soils [3]. The soil samples were analyzed for organic carbon [4], available N [5], available P [6], and available K [7]. Bulk Density was determined by clod method [8].

2.3 Statistical Analysis: The relationship between different soil characteristics and micronutrient contents in soils and plants were determined using correlation coefficients:

$$r = \frac{SP(xy)}{\sqrt{SS(x),\ SS(y)}}$$

Where:

r = Correlation coefficient

SP (xy) = Sum product of x, y variables

SS (x) = Sum of square of x variable

SS (y) = Sum of square of y variable

3. Results and Discussion

3.1. Physicochemical Properties of Soil: The data on pH, EC, B.D, P.D, Porosity and organic carbon are presented in Table 1 and 2. The data shows that the pH of these soils was ranged from 5.9 to 7.6 with average value of 7.03. The lowest pH (5.9) was recorded in soil sample S-17 (B) while highest pH 7.6 was observed in soil sample S-11 & 35, with SD value of 0.399 and CV value of 5.6%. Out of 35 samples 11 soil samples were slightly acidic (pH 5.9 to 6.9), 21 soil samples were neutral (pH 7.1 to 7.4), 3 soil samples were moderately saline (pH 7.5 to 8.0). The soils of Tedia village were slightly acidic to moderately alkaline in reaction. The electrical conductivity of Tedia village was varied from 0.05 to 0.46 dSm^{-1} with an average value of 0.169 dSm^{-1} with SD value of 0.100 and CV value of 59.3%. Bulk density and Particle density ranged from 1.32-1.42 and 2.25-2.42 Mg m^{-3} respectively with a mean of1.37and 2.37Mg $m^{-3.}$ SD and CV of bulk density and particle density were 0.029, 2.15, 0.049 and 2.096 Mg m^{-3}.

The data on percent organic carbon (O.C) content were ranges from 0.32 to 0.77 with a mean value 0.495, with the SD value of organic carbon was 0.11 and CV value of Organic carbon was 23%, respectively. Out of 35 soil samples collected from Tedia village of Arajiline block of Varanasi district 51.4% samples were found low, 45.7% samples were found medium in organic carbon. Thus majority of the soil samples of Tedia village are medium and low in their organic carbon status. The high temperature prevailing in the area is responsible for rapid decomposition of organic carbon. These finding are in agreement with the result reported [9] in soil of North-west plain of Rajasthan.

Table 1. Description of sampling site of Tedia village, Araji line block, Varanasi (U.P.)

S.N.	Cropping system	pH	EC (dSm^{-1})	OC %	Av. N (kg ha^{-1})	Av. P (kg ha^{-1})	Av. K (kg ha^{-1})	BD (g cm^{-3})	PD (g cm^{-3})	Poros-ity (%)
1	Rice-Wheat	7.2	0.15	0.40	120	16.9	230.0	1.35	2.25	40.5
2	Rice-Wheat	7.2	0.14	0.43	128	16.9	268.8	1.33	2.27	44.1
3	Rice-Wheat	7.1	0.16	0.40	120	23.1	237.6	1.34	2.28	44.1
4	Rice-Wheat-Brinjal	7.4	0.12	0.35	104	20.9	184.9	1.33	2.41	58.3
5	Rice-Wheat	7.1	0.17	0.32	96	31.1	210.7	1.34	2.35	51.0
6	Rice-Wheat	6.9	0.21	0.50	150	16.7	125.8	1.35	2.37	52.0
7	Brinjal-Rice	7.1	0.18	0.35	106	19.0	159.1	1.36	2.39	53.0
8	Rice-Wheat	6.9	0.18	0.50	150	24.9	170.9	1.35	2.41	56.1
9	Rice-Wheat	6.8	0.08	0.42	126	21.0	191.3	1.41	2.38	47.0
10	Rice-Wheat	7.5	0.19	0.40	120	16.4	181.7	1.39	2.39	50.0
11	Rice-Wheat	7.6	0.20	0.41	124	29.6	208.5	1.38	2.38	50.0
12	Rice-Wheat	7.2	0.16	0.45	135	20.6	187.0	1.37	2.41	54.0

13	Pea- Sugarcane	7.3	0.20	0.49	146	17.3	194.6	1.42	2.42	50.0
14	Rice-Wheat	7.1	0.15	0.50	150	24.8	140.8	1.32	2.41	59.4
15	Wheat-Sorghum	7.0	0.14	0.53	160	15.8	138.7	1.41	2.42	51.0
16	Pigeon pea– Sesame	6.0	0.06	0.60	180	21.5	162.3	1.33	2.41	58.3
17	Sorghum-Potato	5.9	0.34	0.55	166	17.9	174.1	1.34	2.35	51.0
18	Sorghum-Potato	7.4	0.15	0.33	100	17.0	193.5	1.41	2.36	45.1
19	Urd- Wheat	7.4	0.46	0.40	120	16.4	189.2	1.36	2.40	54.0
20	Sorghum- Wheat	7.1	0.38	0.57	172	18.1	195.6	1.36	2.39	53.0
21	Sesame-Wheat	7.1	0.3	0.41	123	16.6	238.6	1.37	2.40	53.0
22	Sesame-gram-Fallow	7.3	0.10	0.67	200	17.8	133.3	1.38	2.39	51.0
23	Sesame-gram-Fallow	6.3	0.09	0.77	232	33.3	227.9	1.34	2.41	57.2
24	Sesame-Wheat	7.1	0.08	0.41	123	22.4	182.7	1.41	2.42	51.0
25	Sorghum- Wheat	6.6	0.06	0.65	195	14.8	141.9	1.35	2.37	52.0
26	Sorghum- potato	6.9	0.13	0.67	200	29.6	152.6	1.36	2.39	53.0
27	Sorghum- Gram	7.1	0.14	0.53	160	38.6	196.7	1.39	2.41	52.0
28	Sorghum- potato	7.2	0.22	0.67	200	24.3	243.0	1.40	2.40	50.0
29	Sesame-wheat	7.1	0.17	0.37	112	19.6	230.0	1.42	2.38	46.0
30	Jowar-Sarson	7.4	0.16	0.63	189	19.7	188.1	1.35	2.39	54.0
31	Wheat-sorghum	6.4	0.05	0.58	174	16.0	204.2	1.36	2.38	52.0
32	Wheat- pea	6.8	0.05	0.44	132	24.2	222.5	1.40	2.37	47.0
33	Wheat- pea	6.9	0.05	0.60	180	17.9	176.3	1.41	2.39	48.0
34	Wheat, potato- bajra	7.3	0.11	0.49	146	24.8	190.3	1.37	2.25	38.7
35	Wheat- pea	7.6	0.41	0.55	166	18.7	247.3	1.39	2.26	37.8

BD = Bulk density, PD = Particle density, OC = Organic carbon, Av-Available & EC = Electrical conductivity

Table 2. Physicochemical properties soils of Tedia village, Araji line block, Varanasi, (U.P.)

Soil characteristics	Range	Mean	S D	C V (%)
pH (1:2.5)	5.9-7.6	7.03	0.399	5.67
E.C.(dSm^{-1})	0.05-0.46	0.16	0.100	59.34
O.C. (%)	0.32-0.77	0.49	0.113	23.00
B.D. (g cm^{-3})	1.32-1.42	1.37	0.029	2.15
P.D. (g cm^{-3})	2.25-2.42	2.37	0.049	2.09

SD = Standard Deviation, CV = Coefficient of Variation

3.2 Status of Available N, P and K in Soil: The status of N, P and K has been shown in Table 3 and 4 and its subparts. Table 5 shows limits for soil test values used in India [6]. Available nitrogen content of these soils was ranged from 96 to 232 kg ha^{-1} with a mean value of 148.71 kg ha^{-1} with SD value of 34.11and CV value of 22.94%. Out of 35 soil samples collected from Tedia village100% soil samples were found in low range. Climate has a major impact on availability of nitrogen, maximum soil samples were found in low category it may be due to uncertain rainfall. Similar result was observed [10] that the available nitrogen content in soils of Arid Tract of Punjab, India.

The available phosphorous content in these soils were varied from 14.8 to 38.6 kg ha^{-1} with a mean value of 21.26 kg ha^{-1} with SD value of 5.59 and CV value of 26.32%. Out of 35 soil samples collected 85.7% soil samples were found medium, 14.2% soil samples found high in P content. This may be due to phosphorus build up in soil because of high phosphatic fertilizer application. These finding are in agreement with the result reported [11] in soil of Tonk district of Rajasthan.

The potassium content in these soils was ranged from 125.5 to 268.8 kg/ha with a mean value of 192.01 kg ha^{-1} K. SD value 35.29 and CV value of 18.38%. Out of 35 soil samples 5.7% soil samples were found low, 94.2% soil samples were found medium and no any sample founded high in K content.

Table 3. Status of available macronutrients viz. available N, P, and K in soils of Tedia village, Araji line block, Varanasi (U.P.)

Soil characteristics	Range	Mean	S D	C V
Available N (kg ha^{-1})	96.0-232.0	148.71	34.12	22.94
Available P (kg ha^{-1})	14.8-38.6	21.26	5.59	26.32
Available K (kg ha^{-1})	125.8-268.8	192.01	35.29	18.38

Table 4. Classification OC% and available Macro nutrients status content in soils of Tedia village, Araji line block, Varanasi (U.P.)

S.N	Elements	No. of samples	% of samples	No. of samples	% of samples	No. of samples	% of samples
		Low		Medium		High	
1	OC%	18	51.4	16	45.7	1	2.8
2	N	35	100	0	0.0	0	0.0
3	P	0	0.0	30	85.7	5	14.2
4	K	2	5.7	33	94.2	0	0.0

Table 5. Rating limits for soil test values used in India (Muhr*et al.*, 1965)

Nutrients	Rating of the soil test values		
	Low	Medium	High
Organic carbon (%)	< 0.5	0.5 – 0.75	> 0.75
Available N(kg/ha)	<280	280 – 560	>560

Available P (kg/ha)	<12.5	12.5 – 25	>25
Available K (kg/ha)	<135 Deficient	135 – 335 Sufficient	>335

3.3. Correlation between Physicochemical Properties and Available Macro Nutrients in the Soils of Tedia Village: Correlation between physicochemical properties and available macro-nutrients in soils shows in table 6. Since most of the soil Nitrogen is found in organic form, therefore, this relationship was observed. Available nitrogen is positively (0.493**) correlated with pH, negatively (-0.139) correlated with EC, positively (1.000**) correlated with OC, negatively (-0.106) correlated with BD and positively (0.199) correlated with PD. This result was similar as reported [12] in the spatial distribution of micronutrients in soils of Patiala district.

Available phosphorous is positively (0.108) correlated with pH, negatively (-0.205) correlated with EC, positively (0.142) correlated with OC, negatively (-0.109) correlated with BD and positively (0.126) correlated with PD. Available potassium is positively (0.928**) correlated with pH, negatively (-0.002) correlated with EC, positively (0.479**) correlated with OC, positively (0.459**) correlated with BD and positively (0.078) correlated with PD. This result was similar correlation as reported [13].

Table 6. Correlation between physicochemical properties and available macro nutrients in the soil of Tedia village, araji line block, Varanasi, U.P.

	N	P	K	pH	EC	OC	BD	PD
N	1							
	35							
P	0.144	1						
	0.410							
	35	35						
K	0.482**	0.071	1					
	0.003	0.686						
	35	35	35					
	0.493**	0.108	0.928**	1				
pH	0.003	0.538	0.000					
	35	35	35	35				
	-0.139	-0.205	-0.002	0.014	1			
EC	0.425	0.237	0.990	0.936				
	35	35	35	35	35			
	1.000**	0.142	0.479**	0.489**	-0.145	1		
OC	0.000	0.417	0.004	0.003	0.407			
	35	35	35	35	35	35		
	-0.106	-0.109	0.459**	0.457**	-0.058	-0.108	1	
BD	0.545	0.532	0.006	0.006	0.739	0.535		
	35	35	35	35	35	35	35	
	0.199	0.126	0.078	0.330	-0.117	0.197	0.194	1
PD	0.251	0.471	0.656	0.053	0.505	0.256	0.263	
	35	35	35	35	35	35	35	35

***Correlation is significant at 0.01 levels (2- tailed)*

4. Conclusions: It can be concluded that, the soil from Tedia village of Varanasi district is categorized under were slightly acidic to moderately alkaline in reaction. Out of 35 soil samples 45.3% samples were found low, 53.7% samples were found medium in organic carbon in the soils of studied area. Out of 35 soil samples, 100% found in low available nitrogen, available phosphorus found medium (54.6%) to high (44.4%) and available potassium 95% in medium range. The results have shown that the soil of Lahar block in Bhind district has going to start quality deterioration which requires immediate attention on sustainable soil. It is reveals from present study that, in future organic carbon and nitrogen deficiency may be more and main cause of quality deterioration of soil, so it is recommended for study area that for sustainability that adoption of improved package of practices and integrated plant nutrition system.

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