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Soil Fertility Status of Village Dadhorpur, Arajiline Block, District Varanasi, Uttar Pradesh, India

Y.V. Singh, S. K. Singh, P.K. Sharma, R. Meena and S.K. Shahi*

Department of soil science and agricultural chemistry, Institute of Agricultural Sciences
Banaras Hindu University, Varanasi, 221 005 (U.P.)
*Department of Soil Science And Agricultural Chemistry, U.P. College Varanasi- 221002(U.P)
INDIA
E-mail: yvsingh59@rediffmail.co.in

Abstract

A study of the soil fertility status and macronutrient status of soil of dahahorpur, arajiline block, Varanasi district, U.P. was made with study of 35 soil samples of different field spots of the village. The objective of this study was to know about the major nutrients present in soils of farmer field of dadahorpur and relationships with various physiochemical properties. Soil samples were collected at a depth of 0-15 cm and analyzed for available nitrogen, available phosphorous, available potassium, pH, Electrical conductivity, Organic carbon, Bulk density and Particle density by standard procedure. The soil pH ranged from 6.4 to 7.8 reflecting nearly neutral to slightly alkaline in nature. EC ranges between 0.03 to 0.40dSm^{-1}. Organic carbon ranges from 0.33 to 0.68%. 42.85% and 57.14% samples showing low and medium organic carbon status respectively. 100% samples are in low status in available N 42.85%samples show medium status of available P and 54.28% samples are high in available P 100% soil samples are medium in potassium. 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%. Improper agricultural practices, intensive farming, monoculture type of cropping pattern and over irrigation are responsible for degradation of soil fertility from the area. To overcome the adverse effect, complementary use of biofertilizers, 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*

Introduction

Soil fertility is an important factor, which determines the growth of plant. Soil fertility is determined by the presence or absence of nutrients i.e. macro and micro-nutrients. Out of 17 essential plant nutrients N, P, K, Ca, Mg, and S are macronutrients. 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 [2]. 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[5,8]. 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[3] 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 dadhorpur 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 physiochemical properties in the soils of Dadahorpur village arajiline block, district Varanasi.

Materials and Methods

Study area

Dadhorpur 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.

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 ratios) of soils. The soil samples were analyzed for organic carbon [9], available N [7], available P, and available K. Bulk Density was determined by clod method.

Statistical analysis

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

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

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

Results and Discussion

Physico-chemical properties of soil

The data on pH, Electrical Conductivity, Bulk Density and Particle Density, Organic carbon available N, P, and K are presented in Table 1 along with the cropping detail of the farmer's field. The range, average value and standard deviation along with the coefficient of the variation of the physiochemical of the soil samples are sown in Table 2. The data shows that the pH of these soils was ranged from 6.4 to 7.8 with average value of 7.15. The lowest pH 6.4 was recorded in soil samples T-58(C) and T-59(B) while highest pH 7.8 was observed in soil samples T-49(B) and T-66(B). With SD value of 0.37 and CV value of 5.17%. Out of 35samples 8 soil samples were near to neutral (pH6.4 to 6.9), 18 soil samples were neutral (pH7.0 to 7.4), 9 soil samples were moderately saline (pH 7.5 to 7.8). The soils of Dadhorpur village were neutral to moderately alkaline in reaction.

Table 1 Description of sampling site of dadahorpur, araji line block, Varanasi, U.P.

S. No.	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 ($g\ cm^{-3}$)	Porosity (%)
1	Wheat,pea-rice	7.6	0.08	0.33	100	20.3	195.6	1.35	2.25	40.5
2	Bajra-wheat	7.6	0.09	0.55	166	25.1	164.5	1.33	2.27	44.1
3	Bajra-wheat,pea	7.8	0.08	0.55	166	19.7	195.6	1.34	2.28	44.1
4	bajra- wheat -sugarcane	7.5	0.07	0.68	204	30.8	205.3	1.33	2.41	58.3
5	Sugarcane-potato-wheat	7.6	0.09	0.40	120	40.1	230.0	1.34	2.35	51.0
6	Sugarcane-potato-wheat	6.7	0.03	0.41	123	19.7	217.1	1.35	2.37	52.0
7	Sugarcane-wheat-potato	6.7	0.07	0.55	166	20.9	199.9	1.36	2.39	53.0
8	Sugarcane-wheat-potato	7.1	0.37	0.45	135	24.0	207.5	1.35	2.41	56.1
9	Sugarcane-wheat-potato	7.7	0.47	0.40	120	22.1	176.3	1.41	2.38	47.0
10	Sugarcane-potato-rice	7.7	0.40	0.55	166	29.4	218.2	1.39	2.39	50.0
11	Garlic- back gram	7.1	0.40	0.48	144	29.7	236.5	1.38	2.38	50.0
12	Sugarcane-pea	7.0	0.19	0.58	174	28.8	226.8	1.37	2.41	54.0
13	Sesame-potato	7.2	0.20	0.33	100	29.9	213.9	1.42	2.42	50.0
14	Rice-Wheat	7.4	0.13	0.67	200	34.5	210.7	1.32	2.41	59.4
15	Rice-Wheat	7.0	0.11	0.67	200	13.1	152.6	1.41	2.42	51.0
16	Rice-Wheat/pea	6.9	0.10	0.55	166	10.6	206.4	1.33	2.41	58.3
17	Rice-Wheat	7.0	0.15	0.40	120	24.2	183.8	1.34	2.35	51.0
18	Rice-Pigeonpea /Wheat	7.0	0.13	0.57	172	26.9	145.1	1.41	2.36	45.1
19	Pigeonpea-Wheat	6.9	0.19	0.67	200	15.5	138.7	1.36	2.40	54.0
20	Pigeonpea-Wheat	7.3	0.16	0.45	134	23.1	176.3	1.36	2.39	53.0
21	Pigeonpea-Wheat	7.1	0.22	0.55	166	38.6	203.2	1.37	2.40	53.0
22	Fodder-Potato	7.2	0.24	0.49	146	32.6	206.4	1.38	2.39	51.0
23	Sugarcane-Wheat	6.5	0.13	0.67	200	29.7	184.9	1.34	2.41	57.2
24	Rice-Pea/ Wheat-Rice	7.1	0.20	0.45	134	41.9	161.2	1.41	2.42	51.0
25	Chilli-Sugarcane	7.5	0.13	0.67	200	41.1	206.4	1.35	2.37	52.0
26	Wheat/bajra-Potato	7.2	0.13	0.55	166	43.2	225.7	1.36	2.39	53.0
27	Potato/Barli-Pea	7.5	0.14	0.44	132	47.1	194.6	1.39	2.41	52.0
28	Wheat/bajra-Potato	7.3	0.18	0.65	195	26.7	191.3	1.40	2.40	50.0
29	Wheat/bajra-Potato	7.3	0.19	0.60	180	29.4	201.0	1.42	2.38	46.0
30	Wheat/bajra –Potato	7.4	0.11	0.67	200	34.7	206.4	1.35	2.39	54.0
31	Wheat/bajra –Potato	6.4	0.13	0.49	146	17.8	155.9	1.36	2.38	52.0
32	urd+sesame-Wheat	6.5	0.22	0.62	186	15.1	184.9	1.40	2.37	47.0
33	Wheat/urd+till-Wheat	6.4	0.18	0.67	200	17.8	203.2	1.41	2.39	48.0
34	Wheat/bajra-Wheat	7.2	0.11	0.49	146	20.1	229.0	1.37	2.25	38.7
35	gram/ bajra –Wheat	7.1	0.08	0.49	146	13.9	236.5	1.39	2.26	37.8

The electrical conductivity of Dadhorpur village was varied from 0.03 to $0.40dSm^{-1}$ with an average value of $0.21dSm^{-1}$. With SD value of 0.10 and CV value of 47.61%. Bulk density and Particle density ranged from 1.32-1.42and 2.25-2.42Mg m^{-3} respectively with a mean of 1.37 and 2.37 Mg $m^{-3.}$ SD and CV of bulk density and particle density were 0.02, 1.45, 0.04 and 1.68Mg m^{-3}.

The data on percent organic carbon (OC) content were ranges from 0.33 to 0.68 with a mean value 0.53, with the SD value of organic carbon was 0.10 and CV value of Organic carbon was 18.86%, respectively. Out of 35 soil samples collected from Dadhorpur village of arajiline block of Varanasi district 42.85% samples were found low, 57.14% samples were found medium in organic carbon. Thus majority of the soil samples of Dadhorpur

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 by in soil of North-west plain of Rajasthan[4] and in soil of Amritsar district of Punjab[6].

Table 2 Physico-chemical properties soils of dadahorpur, araji line block, Varanasi, U.P.

Soil characteristics	Range	Mean	SD	CV (%)
pH(1:2.5)	6.40-7.80	7.15	0.37	5.17
E.C.(dSm^{-1})	0.03-0.40	0.21	0.10	161.90
O.C. (%)	0.33-0.68	0.53	0.10	18.86
Available N (kg ha^{-1})	100.00-204.00	160.54	31.24	19.45
Available P (kg ha^{-1})	10.60-47.10	26.80	9.33	34.81
Available K (kg ha^{-1})	138.70-236.50	196.89	25.64	13.02
B.D.(g cm^{-3})	1.32-1.42	1.37	0.02	1.45
P.D. (g cm^{-3})	2.25-2.42	2.37	0.04	1.68

SD = Standard Deviation, CV = Coefficient of Variation

Status of available N, P and K in soil

The status of Organic carbon, available N, P and K has been shown in Table 2 and Table 3 shows Rating limits for soil test values used in India [9]. Available nitrogen content of these soils was ranged from 100 to 204 kg ha^{-1} with a mean value of 160.54kg ha^{-1}. SD value of 31.24 and CV value of 19.45%. Out of 35 soil samples collected from Dadhorpur village 100% soil samples were found in low range of available nitrogen in table 4. 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 by that the available nitrogen content in soils of Arid Tract of Punjab, India.

The available phosphorous content in these soils were varied from 10.6 to 47.10 kg ha^{-1} with a mean value of 26.80 kg ha^{-1}. SD Value of 9.33 and CV value of 34.81%. Out of 35 soil samples collected 2.85% soil samples were found low, 42.85% soil samples were found medium, 54.28% soil samples found high in Phosphorous content. This may be due to phosphorus build up in soil because of high phosphatic fertilizer application.

Table 3 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

Table 4 OC% and available Macro nutrients status content in soils of dadahorpur, araji line block, Varanasi, U.P.

S. No.	Elements	Low		Medium		High	
		No. of samples	% of samples	No. of samples	% of samples	No. of samples	% of samples
1	OC%	15	42.85	20	57.14	0	0.00
2	N	35	100.00	0	0.00	0	0.00
3	P	1	2.85	15	42.85	19	54.28
4	K	0	0.00	35	100	0	0.00

The potassium content in these soils was ranged from 138.70 to 236.50 kg/ha with a mean value of 196.89 kg ha^{-1} K. S.D. value 25.64 and C.V. value of 13.02%. Out of 35 soil samples 100% soil samples were found medium and no any sample founded low and high in K content in table 4.

Correlation between physio-chemical properties and available macro nutrients in the soils of dadhorpur village

Correlation between physio-chemical properties and available macro-nutrients in soils shows in table 5. Since most of the soil Nitrogen is found in organic form, therefore, this relationship was observed. Available nitrogen is negatively (-0.194) correlated with pH which means higher the pH shows lower range of nitrogen, negatively (-0.161) correlated with EC means higher the EC shows lower range of nitrogen, positively (1.000**) correlated with OC means higher the OC shows higher the nitrogen, negatively (-0.085) correlated with BD means higher the BD shows lower range of nitrogen and positively (0.301) correlated with PD means higher the PD shows higher range of nitrogen.

Table 5 Correlation between physio-chemical properties and available macro nutrients in the soil of dadahorpur, araji line block, Varanasi, U.P.

	pH	EC	OC	N	P	K	BD	PD
pH	1							
EC	0.131	1						
OC	-0.200	-0.161	1					
N	-0.194	-0.161	1.000**	1				
P	0.403*	0.085	-0.040	-0.040	1			
K	0.195	0.046	-0.173	-0.171	0.244	1		
BD	-0.138	0.414*	-0.083	-0.085	-0.029	-0.158	1	
PD	-0.291	0.312	0.288	0.286	0.301	-0.142	0.194	1

***. Correlation is significant at the 0.05 level (2-tailed).**

Available phosphorous is positively (0.403*) correlated with pH means high level of phosphorous will present at higher pH, positively (0.085) correlated with EC means high level of phosphorous will present at higher EC, negatively (-0.04) correlated with OC means high level of phosphorous will present at lower OC, negatively (-0.029) correlated with

BD means high level of phosphorous will present at lower BD and positively (0.301) correlated with PD means high level of phosphorous will present at higher PD.

Available potassium is positively (0.195) correlated with pH means high level of potassium will present at higher pH, positively (0.046) correlated with EC means high level of potassium will present at higher EC also, negatively (-0.173) correlated with OC means high level of potassium will present at lower OC, negatively (-0.158) correlated with BD means high level of potassium will present at lower BD and negatively (-0.142) correlated with PD means high level of potassium will present at lower PD also[1].

Conclusion

It can be concluded that, the soil from dadhorpur village of varanasi district is categorized under were near to neutral to moderately alkaline in reaction. Out of 35 soil samples 42.85% samples were found low, 57.14% 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 (42.85%) to high (54.28%) and as available potassium point of view 100% soil samples were in medium range.

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