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Evaluation of Soil Fertility Status from Milkipur Village, Arajiline Block, Varanasi, District, Uttar Pradesh, in Relation to Soil Characteristics

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Soil fertility evaluation of an area or region 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 area which was selected for the study is Milkipur. The aim of this study was to evaluate soil fertility status from Milkipur village, Varanasi district, U.P. 38 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 6.5 to 8.0 reflecting nearly neutral to slightly alkaline nature of soils. EC ranges between 0.07 to 0.60dSm^{-1}. Organic carbon ranges from 0.33 to 0.75%.42% samples showing low and 57.89% samples showing 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 1.35 to 1.42Mg m^{-3}, Particle density ranges from 2.24 to 2.39 Mg m^{-3} and Porosity ranges from 36.1 to 54.0%. 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. To overcome the adverse effect, complimentary use of biofertilizers, organic manure in suitable combination of chemical fertilizers were suggested. Awareness camps, rallies and training programmes 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.

Keywords: Soil fertility, Organic matter, Available nutrients & Physico-chemical properties etc.

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 Fageria, 2001[6]. 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

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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 Lal and Singh[13], 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 Milkipurvillage 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 physico-chemical properties in the soils of Milkipurvillage arajiline block, district Varanasi.

MATERIALS AND METHODS

Study area

Milkipur 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. Humidity 54%, temperature July to October 22 and 46°c (72 and 115°F). The average annual rainfall is 1110mm. 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 and analysis

Selected 38 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 Jackson[9].The soil samples were analyzed for organic carbon Walkley and Black[25],available N Subbiah and Asija[23], available P Olsen *et al*.[17], available K Hanway and Heidal[8].

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, EC, B.D., P.D., and organic carbon are presented in Table 1 and 2. The data shows that the pH of these soils was ranged from 6.5 to 8.0 with an average value of 7.24. The lowest pH (6.5) was recorded in soilsample S-1, while highest pH 8.0 was observed in soil sample S 28. With S.D value of 0.399 and C.V. value of 5.6%. Out of 38 samples 6 soil samples were slightly acidic (pH 5.9 to 6.9), 21 soil samples were neutral (pH 7.1 to 7.4), 11 soil samples were moderately saline (pH 7.5 to 8.0). The soils of Milkipur village were slightly neutral to moderately alkaline in reaction.

The electrical conductivity of Milkipur village was varied from 0.07to 0.60 dSm^{-1} with an average value of 0.220 $dSm^{-1}$with S.D. value of 0.100 and C.V. value of 59.3%.Bulk density and Particle density ranged from 1.32-1.42 and 2.25-2.42Mg m^{-3} respectively with a mean of1.37and 2.37Mg $m^{-3.}$ S.D. and C.V. 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 S.D. value of organic carbon was 0.11 and C.V. value of Organic carbon was 23%, respectively. Out of 38 soil samples collected from Milkipur 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 Milkipur 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 Mathur *et al.*[13], in soil of North-west plain of Rajasthan.

Table 1. Description of sampling site of Milkipur village, arajiline 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/urd+till-Wheat	6.5	0.15	0.60	180	14.80	237.60	1.35	2.39	54.00
2	Wheat/ bajra –pea	7.2	0.14	0.40	120	15.10	205.30	1.37	2.38	51.00
3	Wheat/till-Wheat	6.9	0.38	0.55	166	26.40	193.50	1.36	2.29	43.20
4	Wheat/till-Wheat	7.5	0.07	0.48	144	13.00	215.00	1.37	2.38	51.00
5	Wheat/ Rice-Wheat	7.0	0.18	0.45	134	33.60	163.40	1.38	2.39	51.00
6	Rice-Wheat	7.5	0.18	0.42	126	28.50	193.50	1.39	2.38	49.00
7	Sugarcane-Wheat	7.2	0.18	0.40	120	30.80	164.50	1.41	2.37	46.00
8	Rice-Wheat	7.5	0.18	0.49	146	27.20	180.60	1.42	2.27	36.10
9	Rice-Potato-Mung	7.5	0.21	0.57	172	30.90	204.20	1.38	2.24	36.90
10	Rice-Wheat	7.4	0.18	0.52	156	31.40	208.50	1.39	2.25	36.90
11	Rice-urd-Mung	7.4	0.18	0.33	100	23.30	144.00	1.41	2.29	38.70
12	Rice-Wheat	7.1	0.24	0.72	216	29.00	182.70	1.37	2.38	51.00
13	Rice-Wheat	7.5	0.16	0.69	206	26.40	229.00	1.38	2.38	50.00
14	Fodder-Potato-Wheat	7.1	0.23	0.75	225	35.00	230.00	1.37	2.39	52.00
15	Rice-Wheat	7.1	0.22	0.64	192	14.50	209.60	1.39	2.39	50.00
16	Rice-Wheat	7.5	0.25	0.67	200	27.00	220.40	1.36	2.38	52.00
17	Fodder-Potato-Vegetable	7.3	0.24	0.57	172	29.60	177.40	1.41	2.37	46.00
18	Fodder-Potato	7.3	0.14	0.40	120	30.60	153.70	1.42	2.38	46.00
19	Rice-Wheat	7.8	0.52	0.35	106	35.90	144.00	1.37	2.39	52.00
20	Sesame-Wheat	7.3	0.11	0.71	212	27.90	134.40	1.39	2.36	47.00
21	Bajara-Chilli	7.3	0.17	0.71	212	24.30	181.70	1.38	2.35	47.00
22	Rice-wheat,pea	7.3	0.17	0.40	120	33.20	198.90	1.37	2.34	47.00
23	Rice-wheat	6.9	0.14	0.72	216	12.90	130.10	1.38	2.38	50.00
24	Rice-wheat-sugarcane	6.7	0.20	0.69	206	21.30	206.40	1.39	2.39	50.00
25	Rice-wheat-sugarcane	6.6	0.15	0.62	186	30.50	229.00	1.35	2.37	52.00
26	Rice-wheat	7.7	0.17	0.60	180	20.64	216.10	1.36	2.34	48.00
27	Rice-wheat	7.5	0.17	0.60	180	31.88	195.60	1.42	2.31	39.60
28	Rice-wheat	8.0	0.22	0.44	132	32.48	210.70	1.41	2.29	38.70
29	Rice-wheat	7.7	0.55	0.44	132	17.50	180.60	1.37	2.28	41.40
30	Rice-wheat	7.1	0.43	0.71	213	24.24	237.60	1.38	2.37	49.00
31	Rice-wheat	6.6	0.20	0.40	120	34.13	230.00	1.39	2.38	49.00
32	Rice-wheat	7.1	0.16	0.73	220	26.49	268.80	1.41	2.39	48.00
33	Rice-potato	7.4	0.18	0.40	120	26.79	237.60	1.40	2.37	47.00
34	Bajara,rice-wheat	7.1	0.13	0.65	195	33.68	184.90	1.39	2.38	49.00
35	Rice-wheat	7.2	0.60	0.64	192	17.20	210.70	1.37	2.37	50.00
36	Rice-wheat	7.2	0.18	0.75	226	20.19	125.80	1.38	2.38	50.00
37	Rice-wheat	7.0	0.17	0.42	126	28.14	159.10	1.39	2.38	49.00
38	Rice-wheat	7.3	0.24	0.40	120	22.74	170.90	1.37	2.39	52.00

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

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 Muhr *et al.*[15].Available nitrogen content of these soils were ranged from 100 to 226 kg ha^{-1} with a mean value of 166.02 kg ha^{-1}. S.D. value of 39.515 and C.V. value of 23.8%. Out of 38 soil samples collected from Milkipur village 100% 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 by Verma *et al*.[24], that the available nitrogen content in soils of Arid Tract of Punjab, India.

The available phosphorous content in these soils were varied from 12.9 to 35.9 kg ha^{-1} with a mean value of 26.03 kg ha^{-1}.S.D value of

Table 2. Physico-chemical properties soils of Milkipur village, arajiline block, Varanasi, U.P.

Soil characteristics	Range	Mean	S.D.	C.V. (%)
pH(1:2.5)	6.5-8.0	7.24	0.32	5.67
E.C.(dSm^{-1})	0.07-0.60	0.22	0.11	59.34
O.C. (%)	0.32-0.77	0.55	0.13	23.00
B.D.(g cm^{-3})	1.32-1.42	1.38	0.01	2.15
P.D. (g cm^{-3})	2.25-2.42	2.35	0.04	2.09

Table 3. Status of available macronutrients viz. available N, P, and K in soils of Milkipur village, arajiline block, Varanasi, U.P.

Soil characteristics	Range	Mean	S.D.	C.V.
Available N (kg ha^{-1})	100-226	166.02	39.515	23.80
Available P (kg ha^{-1})	12.9-35.9	26.03	6.535	25.10
Available K (kg ha^{-1})	125.8-237.6	193.83	33.582	17.32

Table 4. Classification OC% and available Macro nutrients status content in soils of Milkipur village, arajiline block, Varanasi, U.P.

S. No.	Elements	No. of samples	% of samples	No. of samples	% of samples	No. of samples	% of samples
		Low		Medium		High	
1	OC %	16	42.10	16	45.7	1	2.8
2	N	38	100	0	0.0	0	0.0
3	P	0	0.0	14	36.84	24	63.15
4	K	3	7.89	31	81.57	4	10.52

Table 5. Rating limits for soil test values used in India (Muhr *et al.,* 1965)[14]

Nutrients	Rating of the soil test values		
	Low	Medium	High
Organic carbon (%)	< 0.5	0.5 – 0.75	> 0.75
Available N(kg ha^{-1})	<280	280 – 560	>560
Available P (kg ha^{-1})	<12.5	12.5 – 25	>25
Available K (kg ha^{-1})	<135Deficient	135 – 335Sufficient	>335

Table 6. Correlations between physic- chemical properties and available macro nutrients in the soil of Milkipur village, Araji line block, Varanasi, U.P.

	N	P	K	pH	EC	OC	BD	PD
N	1							
	38							
P	-.195	1						
	.241							
	38	38						
K	.201	-.017	1					
	.226	.919						
	38	38	38					
pH	-.286	.133	-.152	1				
	.082	.427	.364					
	38	38	38	38				
EC	-.046	-.047	.006	.189	1			
	.785	.781	.971	.257				
	38	38	38	38	38			
OC	1.000**	-.195	.202	-.286	-.049	1		
	.000	.241	.225	.082	.770			
	38	38	38	38	38	38		
BD	-.222	.298	-.199	.259	-.253	-.222	1	
	.181	.069	.232	.116	.126	.181		
	38	38	38	38	38	38	38	
PD	.209	-.145	.048	-.428**	-.128	.211	-.214	1
	.208	.385	.777	.007	.444	.203	.197	
	38	38	38	38	38	38	38	38

**. Correlation is significant at the 0.01 level (2-tailed).

6.535 and C.V. value of 25.10%. Out of 38 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 by Meena *et al*. in soil of Tonk district of Rajasthan[16].

The potassium content in these soils was ranged from 125.8 to 237.6 kg/ha with a mean value of 193.83 kg ha^{-1} K. S.D. value 35.58 and C.V. value of 17.32%. Out of 38 soil samples 5.7% soil samples were found low, 94.2% soil samples were found medium and no any sample founded highin K content.

Correlation between physico-chemical properties and available macro nutrients in the soils of Milkipur village

Correlation between physico-chemical 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 negatively (-0.286**) correlated with pH, negatively (-0.046) correlated with EC, positively (1.000**) correlated with OC, negatively (-0.222) correlated with BD and positively (0.209) correlated with PD[19,20].

Available phosphorous is positively (0.071) correlated with pH, positively (0.211) correlated with EC, positively (0.200) correlated with OC, positively (0.149) correlated with BD and positively (0.145) correlated with PD.The relationship between available P and C level could not exhibit the concurrent results. Jatav and Mishra have also reported the similar results in soil of Mewar region of Rajasthan and Janjigar district of Chhattishgarh[10].

Available potassium is negatively (-0.152) correlated with pH, positively (-0.006) correlated with EC, positively (0.202) correlated with OC, Negatively (0.199) correlated with BD and positively (0.048) correlated with PD[2].

CONCLUSION

It can be concluded that, the soil from Milkipur village of varanasi district is categorized under were slightly neutral to moderately alkaline in reaction. Out of 38soil samples 41.10% samples were found low, 45.7% samples were found medium&2.8% High in organic carbon in the soils of studied area. Out of 38 soil samples, 100% found in low available nitrogen, available phosphorus found medium 36.84% to high 63.15% and available potassium 7.89% found in low, 81.57% found in medium & 10.52% found high range.

Improper agriculture practices, intensive farming, monoculture type of cropping pattern and over irrigation are responsible for the deterioration of soil quality in the area. To overcome the adverse effect of these chemical cultivation efforts should be made to exploit all the available resource of nutrients under the theme of integrated nutrient management (INM). Under this approach the best available option lies in the complimentary use of biofertilizers[5], organic manures in suitable combination of chemical fertilizers. 'Organic agriculture' system should be inoculated which begins to consider potential environmental and social impacts by eliminating the use of synthetic inputs such as synthetic fertilizers, pesticides etc. The camps, rallies and training programmesfor the farmers should be arranged for increasing awareness regarding the benefits of organic agriculture, biofertilizersetc in crop production and thereby improving soil fertility and nutrients status [3,4].

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