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Delineation of soil fertility status of Reoti block of Ballia district (U. P.)

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Abstract

The experiment was carried out by collected surface soil samples from 30 villages composite surface soil sample (0-15 cm) from villages of Reoti block of Ballia district to evaluated soil fertility status *viz*. physico-chemical and chemical properties of soil for nutrients index by used of standard procedure. The pH value of soils of Reoti block varied from 7.50 to 8.82 , soil EC value have ranged from 1.00 to 1.08 dSm^{-1} , bulk density ranged from 1.28 to1.58 Mg m^{-3} Water Holding Capacity was of different village with mean value of 43.26 %, Organic carbon content was ranged from 0.15 to 0.92 %, available nitrogen content were varied from 192.76 to 300.52 $kgha^{-1}$, available phosphorus content was 9.50 to 15.80 kg ha^{-1}, available potassium was ranged from 358.4 to 492.8 kg ha^{-1}, available sulphur was varied from 4.30 to 6.10 mg kg^{-1}, free $CaCO_3$ content was ranged from 0.87 to 2.5 %. The nutrient index value of Reoti block soil samples for available nitrogen 1.16, available phosphorus 1.96 and available potassium was 3.0 respectively.

Keywords: Soil organic Carbon, Available N, P, K, S, Nutrient index value

Introduction

The composition and proportion of different components on the earth is greatly influence by soil properties. The organic matter of soil, although represents less than 10% of the soil mass by weight, has a great effect on soil chemical and physical properties. Soil organic matter comprises of carbon, oxygen, hydrogen, nitrogen and smaller quantities of sulphur and other element. The inorganic and organic proportion of components are quantify the physical, chemical and biological parameters that has a major impact on agricultural productivity and sustainability. Soil fertility refers to inherent capacity of a soil to supply essential nutrient to plant in adequate and right proportion for optimum growth is one of the key components to determine productivity management. Indian soil demand its build up and sustain at a high level to produce adequate food to food to feed its burgeoning population. The management of soil fertility vis-a- vis nutrient management at optimum level is one of the key factors in achieving high and sustainable productivity. As a consequence deficiencies of nitrogen, phosphorous, potassium, sulphur, zinc have been reported to the extent of 89, 80, 50, 41 and 48% respectively (Singh, 2008). Soil characteristics in relation to evaluation of fertility status of soil of an area is important aspect in context to sustainable agriculture production. Because of imbalance and inadequate fertilizer use coupled with low

efficiency of other inputs (Dutta and Bhattacharya, 2001). The efficiency tremendously under intensive agriculture in recent years. Ballia District, the eastern most part of Uttar Pradesh and Reoti block is bounded by Ballia Tehsil towards east, Belhari Tehsil towards East, Hanumanganj tehsil towards west Bansdih tehsil towards North and Bairiya tehsil towards east. An attempt was also made to correlate soil available nutrients content with other relevant properties of soils. So the information regarding physico-chemical properties and fertility status of soil of Reoti is undertaken.

Materials and method

Location and Climatic Condition- Ballia distict lies between the parallel of 25°45'37" North lalitude and 84°08'49" East longitude. The total area is 2981 km^2 . The mean sea level of Ballia is 57-69 metre. The average annual precipitation of Ballia is 1608.9 mm. The average temperature of Ballia is 25.4°C in which maximum to 39.9°C and minimum at 7.3°C. The geomorphological regarding major physiographic units are older and younger alluvium major drainages are Ganga and Ghaghra. The net sown area consisting 2187.43 km^2 in cultivable area of 2992.65 km^2 . The major soil type of Ballia is Sandy loam. Study area Reoti Block is belongs to Bairiya Tehsil of Ballia District.

Selection of site - Surface Soil samples were collected from rainfed area of Reoti Block village's viz. Trikalpur, Aasmanthotha, Husenabad, Binha, Bhopatpur, Naina, Pakha, Kusauri kala, Kushar, Shobhnathpur, Rekhaha, Udha, Rampur, Mashrik, Chhaprasarib, Dahtha, Lamhi, Bhaisha, Hariha kala, Bhojchhapra, Chaubeychhapra, Rampur, Chhedi, Munchhapra, Parasiya, Pacharukha, Gayghat, Belaharia, Khanchanpur, Harpur, Muradih, soils from the field of well cultivated area. Sampling sites were carefully chosen taking in into consideration the ground cover, micro relief, degree of erosion, surface drainage, proximity to stress and all other factors likely to affect the soil in comparison with the normal type.

Collection of Soil Sample-The composite surface Soil Sample (0-15 cm) were collected from Reoti block village of Ballia district. Soil sampling was done from a block of 30 villages in after harvesting crop field. About 2 kg of soil from each were fine spot of each village were taken in polythene bag than prepare the composite sample of each village. Soil samples were collected by the help of khurpi, scale and bucket. After well processing soil samples were ready to analysis of targeted possible parameters in the laboratory of Department of Agricultural Chemistry and Soil Science, S. M. M. Town P.G. College, Ballia.

Preparation of soil samples -About 2 kg per sample and each spot of fresh surface soil samples were separately collected and processed and air dried, powdered and sieved through 2 mm brass sieve and stored separately in polythene bag for physical and chemical analysis.

Observation The collected soil samples from the 30 villages surface soil samples were analyses for soil pH, E.C., Bulk density, WHC, Organic carbon, Available N, P, K and S and $CaCO_3$ (%) by using standard method described by different authors. Water Holding Capacity of soil by gravimetric method, bulk density was determined by method described in method by Kanwar and Chopra (1998), Soil pH was determined with glass electrode Buckman pH meter in 1:2.5 ratio of soil water suspension method described by (Jackson, 1973). Electrical Conductivity (E.C.) by of the supernatant liquid of the 1:2.5 ratio of soil-water suspension was determined by conductivity meter method as described by (Jackson, 1973). Organic carbon content of soil was determined by Walkley's and Black's (1934) rapid titration method as described by Kanwar and Chopra (1998). Calcium carbonate was determined by rapid titration method (Puri, 1930), Available N was determined by alkaline potassium permanganate method (Subbiah and

Asija, 1956). Available P was estimated by using Olsen's *et al.* (1954) method. Ammonium acetate extractable method described by Muhr *et al.*, (1965) was used. Sulphur content of soil was determined by Williams and Steinberg (1959). Nutrient Index- Fertilizer recommendations in this approach are based on the Nutrient Index (NI) value with respect to an individual nutrient for a given area (*i.e.*, village, block, district *etc.*). For developing the NI, sufficient number of soil samples representing entire area should be analyzed and grouped into low, medium and high categories. Thereafter, NI is computed following the relationship given by Parker *et al.* (1951). If all samples fall in low category, then the NI will be 1, and when all samples fall in high category the NI will be 3. Parker *et al.* (1951) proposed the NI ratings of <1.5, 1.5-2.5 and >2.5 to represent low, medium and high fertility of soils of the given area, respectively. Later, Ramamoorthy and Bajaj (1969) modified these limits as <1.67 for low, 1.67 to 2.33 for medium, and >2.33 for high fertility categories to avoid undue weightage on medium category.

Results and discussion

Soil pH -Data related to pH of soils of different village of Reoti block (table 1). It has evident that soil pH varied from 7.50 to 8.86 value of classification of soil reaction suggested by Brady (1985). The pH of total soil samples were ranged from under slight to moderate (pH 7.50 to 8.82) alkaline in nature. The maximum soil pH 8.82 was found in sample of Pacharukha and minimum 7.50 pH were observed in sample Udha it might be due to pedogenic process of soil and land form (Singh *et al.*2023).

Electrical conductivity (EC)-The perusal of data is present in table 1 for soil EC for different village of Reoti block soils range from 0.36 to 1.00 dSm-1 with mean value 1.02. The maximum value of electrical conductivity (1.085 dSm^{-1}) was obtained in sample No. 21 Rampur and minimum value of electrical conductivity (0.360 dSm^{-1}) in Sample No. 1 Trikalpur it might be ascribed to the lateral movement of water from the construction of earthen bund of ground (Mehta *et al.*1996). Electrical conductivity was varied between 0.360 and 1.085 dSm^{-1} characteristics of the normal black alluvial soil (Singh *et al.*,2019). But it has not much more variation among the village of Reoti block.

Bulk density (Mg m^{-3})-The bulk density of soil is presented in table 1 was ranged from 1.28 to 1.58 Mg m^{-3} with mean value 1.37, the highest value of bulk density (1.58 Mg m^{-3}) was observed in sample number 22 Chhedi village while minimum bulk density value (1.28 Mg m^{-3}) was found in sample number-2 Aasman Thotha village it might be due the cultural practices for rice and wheat.

Water Holding Capacity (%)-The water holding capacity value was comparatively higher with the mean value of with standard deviation 4.55 then the recently developed cultivated soils of Reoti block varied ranged of 40.60 to 46.73%. The highest water holding capacity was 46.76% and the lowest water holding capacity was 40.60%. Thus, the major soil physical constraints might be Bharthaw soil i.e. low water retentions and high permeability, slow permeability surface and subsurface mechanical impedance and shallow depth (Singh *et al.*, 2020) of the soils which either restrict crop growth or reduce efficiency of basic input such as water movement, aeration and fertilizer etc.

Organic Carbon Content (%)-It is evident from table 1 that percent organic carbon status was ranged from 0.92- 0.25% with average value of 0.49% and S.D. 0.75, the maximum organic carbon content (0.92%) was found in sample number-5 Bhopatpur and minimum (0.25%) in the sample number 24 Parasiya. Differences in organic carbon content of the soil and high rate of possible CO_2 evolution leads to low organic carbon similar finding were given Chaudhary (2013) and Ranjan *et al.* (2018). Organic carbon content was indicating the huge variation in soil of village might be due to different land use

system and no application of organic manure as well as some pedogenic process which leads to oxidation of organic matter in CO_2.

Calcium Carbonate Content (%)-Data is presented in table 2 on $CaCO_3$ content in different village of Reoti block of the Ballia district, the free $CaCO_3$ was varied from1.0 to 2.5 mean value 1.48 S.D. 1.19. Maximum 2.5 value in obtained from village and lowest in 1.0 village of Reoti. The soil of Reoti block have higher $CaCO_3$ than soil of Reoti might be due to climate condition and deposition of climate in that semi-arid region rain water will sink into the ground very quickly.Later as the surface dries out the water below the surface soil will basic carrying dissolve minerals (Prasad and Singh,2000) from lower layer upward with it.

Table.1- Physico-chemical status of different village of Reoti block soils

S.No.	Village Name	E.C. (dSm^{-1})	B.D.(Mgm^{-3})	WHC (%)	O.C (%)
1.	Trikalpur	1.04	1.35	40.60	0.35
2.	Aasmanthotha	0.96	1.29	42.61	0.47
3.	Husenabad	1.08	1.34	46.19	0.80
4.	Binha	1.04	1.32	42.73	0.73
5.	Bhopatpur	1.03	1.45	42.56	0.92
6.	Naina	1.01	1.35	42.40	0.39
7.	Pakha	1.01	1.37	42.49	0.39
8.	Kusaini Kala	1.04	1.40	42.34	0.47
9.	Kusahar	1.04	1.39	42.51	0.47
10.	Shobhnath pur	1.04	1.40	42.56	0.61
11.	Rakhaha	1.05	1.45	42.66	0.67
12.	Udha	1.04	1.53	42.61	0.23
13.	Rampur	1.05	1.45	42.38	0.39
14.	Chhaprasarib	1.05	1.45	42.59	0.53
15.	Datha	1.05	1.41	42.51	0.39
16.	Lamhi	1.05	1.30	45.94	0.47
17.	Bhaisha	1.04	1.51	46.93	0.39
18.	Hariha Kala	1.04	1.54	44.39	0.77
19.	Bhoj Chhapara	1.05	1.44	44.33	0.64
20.	Chaubeychhapra	1.05	1.61	45.81	0.67
21.	Rampur	1.08	1.45	44.36	0.31
22.	Chhedi	1.06	1.59	41.65	0.23
23.	Munchhapra	1.06	1.47	41.91	0.77
24.	Parasiya	1.05	1.42	44.53	0.25
25.	Pacharukha	1.05	1.35	43.23	0.61
26.	Gayghat	1.04	1.31	42.39	0.23
27.	Belahari	1.08	1.45	40.84	0.67
28.	Kanchanpur	1.06	1.43	46.73	0.39
29.	Harpur	1.05	1.38	40.60	0.47

30.	Muradih	1.06	1.47	42.61	0.61

Available Nitrogen (kg ha^{-1})- Data is presented in table 2 for available N content in different village soil of Reoti block was varied from 192.76 to 287.56 kg ha^{-1} with the mean value of 246.73 kg/ha and S.D. 26.73. The maximum amount 287.56 kg/ha of available nitrogen was found in the sample 9- village Kushar while minimum 192.76 was observed in sample number -7 village Pakha. On the basis of the rating suggested by Subbiah and Asijia (1956) almost all the soil sample were found medium to lower range. It has quite obvious that efficiency of applied N was medium due to the fact that N is lost through various mechanism like NH_3 volatilization nitrification, succeeding denitrification, chemical and microbial fixation, leaching and runoff (Sharma *et al*. 2008).

Available Phosphorous (kg ha^{-1}**)-** available phosphorous status (table 2) was ranged from 9.50 to 15.80 kg ha^{-1} with mean value of 12.37 kg ha^{-1} and S.D. 3.4. The maximum amount of available phosphorous 15.80 kg ha^{-1} was found in sample number 30 village Muradih and the minimum 9.50 kg ha^{-1}, was observed of sample 23 village Munchhapra. On the basis of limits all the soil sample were found to be low to medium range of all village of Reoti block. The broad variation of available phosphorous in among the village of their surface soil might be due to pedogenic process as well as application pattern of organic and inorganic fertilizer which leads to fixation capacity (Singh and Diwakar,2000).

Available Potassium (kg ha^{-1})- Available potassium status (table 2) in the soil was ranged from 358.4 to 492.8 kg ha^{-1} with mean value of 366.24 kg ha^{-1} and S.D.18.81. The maximum status of available potassium 492.8 (kg ha^{-1}) was found in sample number 28 Kanchanpur. The greater amount of available K in maximum might be due to dominating clay minerals which have source of K solubilization.

Available Sulphur (mg kg^{-1})-The data presented in table 2 on available sulphur in the soil of Reoti block where ranged from 4.30 to 6.10 mg kg^{-1} respectively. The available sulphur varied with average content 5.10 mg kg^{-1} with S.D. 2.22. The maximum value was observed from 6.0 mg/kg in sample number 11 village Rakhaha, while minimum value was recorded (4.30 mg kg^{-1}) in 14 sample village number 1 Chhaprasarib. The available sulphur in the soil of Reoti block was ranged between low to medium might be due to low organic carbon content and sulphur inducing sources which are eliminate the sulphur enrichment (Kumar *et al.*,2021) of cropping system.

Table. 2- Chemical properties of different village surface soils of Reoti block

S.No.	Village	$CaCO_3$ (%)	Available-N (kg ha^{-1})	Available-P (kg ha^{-1})	Available-K (kg ha^{-1})	Available-S (mg kg^{-1})
1.	Trikalpur	0.87	227.52	12.32	392	4.60
2.	Aasmanthotha	1.12	205.4	12.88	358.4	4.56
3.	Husenabad	1.62	249.64	11.20	425.6	4.75
4.	Binha	1.0	243.32	14.56	436.8	4.60
5.	Bhopatpur	1.5	243.00	11.6	392.00	5.87
6.	Naina	1.2	259.12	14.00	380.8	5.75
7.	Pakha	1.3	192.76	12.80	392.00	4.50
8.	Kusaini Kala	1.6	273.00	11.76	358.4	4.60
9.	Kusahar	1.1	287.56	13.44	414.4	4.50
10.	Shobhnath pur	1.6	282.82	10.08	392.00	5.50

11.	Rakhaha	1.2	237.00	11.20	448.00	6.00
12.	Udha	1.1	300.2	14.00	414.40	5.60
13.	Rampur	1.3	195.92	12.88	470.4	5.75
14.	Chhaprasarib	1.5	269.12	15.68	392.00	4.30
15.	Datha	1.2	205.4	12.32	414.4	5.25
16.	Lamhi	2.1	233.84	10.08	403.2	4.50
17.	Bhaisha	1.7	252.8	12.32	448	5.80
18.	Hariha Kala	1.3	271.76	14.56	436.8	4.60
19.	Bhoj Chhapara	1.2	281.24	10.08	425.6	5.60
20.	Chaubeychhapra	2.5	274.92	12.32	403.2	4.75
21.	Rampur	1.4	211.72	13.44	448	4.50
22.	Chhedi	2.1	252.8	11.20	470.4	4.75
23.	Munchhapra	1.75	205.4	9.50	436.8	5.80
24.	Parasiya	2.1	224.36	10.64	448	4.75
25.	Pacharukha	2.0	259.12	11.76	459.2	5.60
26.	Gayghat	1.3	268.6	14.00	448.00	5.66
27.	Belahari	1.5	237	10.08	470.4	5.62
28.	Kanchanpur	1.5	281.24	11.20	492.8	4.75
29.	Harpur	1.2	274.92	13.44	436.8	6.0
30.	Muradih	1.7	259.12	15.80	392	5.60

Nutrient index- Data presented of nutrient index in table 3 from different village of Nagra block soil was low, medium and high. The NI ratings of <1.5, 1.5-2.5 and >2.5 to represent low, medium and high fertility of soils of the given area, respectively. The nutrient index of available nitrogen was 1.16 falls in low fertility level. The nutrient index of available phosphorus was 1.96 falls in medium fertility level (Singh *et al.* 2023). The nutrient index available potassium was 3.0 falls in high fertility (Nayak and Chaudhary, 2016) level appeared.

Table .3- Nutrient index of different village surface soil of Reoti block of Ballia district

S. No.	Village	Available Nitrogen			Available Phosphorous			Available Potassium		
		Low	Medium	High	Low	Medium	High	Low	Medium	High
1.	Trikalpur	22.752				12.32				392
2.	Aasmanthotha	205.4				12.88				358.4
3.	Husenabad	249.64				11.20				425.6
4.	Binha	243.32				14.56				436.8
5.	Bhoptpur	237				11.76				392.0
6.	Naina	259.12				14.00				380.8
7.	Pakha	192.76				12.80				392.0
8.	Kusaini Kala	237				11.76				358.4
9.	Kusahar		287.56			13.44				414.4
10.	Shobhnath pur		282.82			10.08				392.0
11.	Rakhaha	237				11.20				448.0
12.	Udha		300.2			14.00				414.4
13.	Rampur	195.92				12.88				470

14.	Chhaprasarib	259.12				15.68				392.0
15.	Datha	205.4				12.32				414.0
16.	Lamhi	233.84				10.08				403.2
17.	Bhaisha	252.8				12.32				448.0
18.	Hariha Kala	271.76				14.56				436.8
19.	Bhoj Chhapara		281.24			10.08				425.6
20.	Chaubeychhapra	274.92				12.32				403.2
21.	Rampur	211.72				13.44				448.0
22.	Chhedi	252.8				11.20				470.4
23.	Munchhapra	205.4				9.50				436.8
24.	Parasiya	224.36				10.64				448.0
25.	Pacharukha	239.12				11.76				459.2
26.	Gayghat	268.6				14.00				448.0
27.	Belahari	237				10.08				470.4
28.	Kanchanpur		281.24			11.20				492.8
29.	Harpur	274.92				13.44				436.8
30.	Muradih	259.12				15.80				432.0

Conclusion- The pH value of soils of Reoti block varied from slightly alkaline in nature among the village. Soil EC value has not much more variation in among the village. Bulk density and water holding capacity of different village soils were found in suitable for most of village. Organic carbon content of soils of Reoti block ranged from lower to higher range. Available nitrogen and phosphorus content in soils of different villages were under studied varied lower to medium range. The available sulphur content was found in lower range, free $CaCO_3$ content was varies from very low to extreme high content. The nutrient index value of Reoti block soil samples for available nitrogen was falls in low fertility level, available phosphorus was fall in medium fertility status.

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