Environment & Ecology 29 (2A) : 811—814, 2011
 ISSN 0970-0420

Characterization of Soils of Aligarh, Uttar Pradesh Under Intensive Cultivation

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Abstract

A research investigation was undertaken during 2004-05 to evaluate the fertility status and some important physico-chemical characteristics of the soils. Sixty soil samples from intensively cultivated fields were collected from 20 villages of Aligarh district. The soils of most of the villages were low in organic carbon and all soil samples were low in available nitrogen. Available phosphorus content in the soils ranged from low to high but 90% soils were medium in available phosphorus. Available potassium content in the district ranged from 65.5 to 400 kg/ha. On the basis of average potassium content, 45, 25 and 30% villages fell into low, medium and high range of available potassium, respectively. The bulk density, particle density and porosity of the soils varied from 1.46 to 1.64 g/cc, 2.56 to 2.72 g/cc and 39.7 to 43.9%, respectively. Most of the soils are alkaline in reaction and harmless in total salt content. The calcium carbonate content of the soils ranged from 0.75 to 2.25% and SAR value of the soils varied from 2.70 to 9.01. The cationic composition of saturated extract of most of the soils was Na-(Ca + Mg)-K type. While the anionic composition of the extract of most of the soil samples was SO_4 – (CO_3 + HCO_3) – Cl type.
Key words : Fertility status, Porosity, SAR, Cationic and anionic composition.

Soil is the most important natural resource which supplies food, fodder, fuel and feed requirements of human and animal population. Growing of crops based on soil and climate requirements has been an age old practice. Soil being the main component of the overall production system reacts with crop characteristics, climate and management in determining the final productivity. The critical factor for soil to enable it for producing more is soil fertility, because soil is not an inexhaustible store of plant nutrients. Thus productivity of a soil depends on its nature and quality; as such knowledge about the physico-chemical characteristics of soil is of prime importance for the optimum use of land for increasing crop production. Information about the present status of the physico-chemical properties of soils is essential for bushing advanced technologies for production. Information on the nutritional status of an area can go a long way in planning judicious fertilizers and soil management. Soil salinity and alkalinity have been recognized as an important agricultural problem which adversely affects the crop production of area. Hence a research investigation was undertaken to study the physico-chemical properties of soils of Aligarh, Uttar Pradesh.

Methods

Sixty soil samples (0—20 cm) were collected from twenty villages of the Aligarh district of Uttar Pradesh. Soil samples were collected from the cultivable fields (having 200% or more cropping intensity) of three different locations of the village. Soil samples were air-dried, grind and sieved through a 2 mm sieve for analysis. Soil samples were analyzed for organic carbon, available nitrogen, phosphorus and potash, bulk density, particle density, free $CaCO_3$, by adopting standard methods of analysis. The pH, ECe, ionic composition of saturated extract and SAR were analyzed adopting the procedure suggested by Richards (1). Organic carbon was determined by Walkley and Black method (2), available nitrogen by alkaline permanganate method (3), available phosphorus by Olsen method (4). Nutrient index values for different nutrients were calculated to depict the nutrient status of the study area. Porosity of the soils was determined

Table 1. Organic carbon, available N, P and K, bulk density, particle density and porosity of the soils of Aligarh.

	Name of the village	Organic carbon (%)	Available nitrogen (kg/ha)	Available phosphorus (kg/ha)	Available potassium (kg/ha)	Bulk density (g/cc)	Particle density (g/cc)	Porosity (%)
1	Atalpur	0.287	154.2	13.0	97.2	1.53	2.68	42.9
2	Palampur	0.484	254.2	17.9	366.8	1.48	2.59	42.7
3	Bhojaka	0.412	243.4	16.5	350.2	1.49	2.58	42.8
4	Diwa Hamidpur	0.336	169.2	15.8	175.4	1.51	2.65	43.0
5	Ganeshpur	0.120	145.6	18.0	80.0	1.64	2.72	39.7
6	Girdharpur	0.378	245.2	21.6	327.4	1.50	2.64	43.3
7	Hardaspur	0.380	177.6	16.4	114.0	1.52	2.66	42.9
8	Havibpur	0.172	123.2	07.1	101.5	1.62	2.70	40.0
9	Kajrauth	0.324	162.4	29.2	200.0	1.49	2.63	43.4
10	Kalyanpur Rani	0.246	148.4	12.4	120.0	1.57	2.68	41.5
11	Karsua	0.357	190.4	17.2	120.0	1.50	2.65	43.4
12	Lhosara	0.287	154.2	13.0	97.2	1.55	2.67	42.0
13	Lodha	0.309	165.2	14.9	104.0	1.52	2.66	42.9
14	Pali	0.483	189.8	14.8	320.0	1.47	2.62	43.9
15	Prempur	0.528	277.2	19.6	400.0	1.46	2.57	43.2
16	Rajpur	0.319	159.2	14.9	70.8	1.50	2.65	43.4
17	Resari	0.360	179.2	16.8	80.0	1.50	2.65	43.5
18	Rooppur	0.292	150.0	13.0	65.5	1.54	2.69	42.6
19	Shadipur	0.512	266.8	18.4	382.0	1.46	2.56	43.0
20	Umari	0.183	127.4	15.7	70.0	1.60	2.72	41.2
	Nutrient Index	1.1	1.03	2.0	1.85			

by using relationship of bulk density and particle density.

Results and Discussion

Organic Carbon

Organic carbon content of the soils of Aligarh district varied from 0.120 to 0.528% with an average of 0.338% (Table 1). Nutrient index for organic carbon was 1.1 which denotes the low fertility status with regard to organic carbon. Minimum organic carbon was recorded in Ganeshpur village soils. While the maximum organic carbon was found in soils of Prempur village. Data show that out of 20 villages only two villages fell in medium category of organic carbon. Rest 18 villages fells in low range of organic carbon. The results corroborate the findings of Sharma and Pal (5).

Available Nitrogen, Phosphorus and Potassium

Available nitrogen, phosphorus and potassium content of the soils varies from 123.2 to 277.2 kg/ha, 7.10 to 29.2 kg/ha and 65.5 to 400.0 kg/ha with an average of 184.14 kg/ha, 16.31 kg/ha and 182.1 kg/ha, respectively. The nutrient index for nitrogen, phosphorus and potassium was calculated 1.03, 2.0 and 1.85, respectively. On the basis of nutrient index, soils of Aligarh district were low, medium and medium in available nitrogen, phosphorus and potassium, respectively. All soil samples were low in available nitrogen but relatively higher amount (277.2 kg/ha) of available nitrogen was found in Prempur village soils. Mostly soil samples were medium in case of available phosphorus. While soils of Kajrauth village were high for this nutrient. The soils were low to high in available potassium. On the basis of mean potassium content, nine, five and six villages contain low, medium and high potassium content, respectively. The probable reason for low content of available nutrient under cultivated lands is the low organic matter content in soils. Similar results were reported by Tripathi et al. (6).

Bulk Density, Particle Density and Porosity

Bulk density of the soils ranged from 1.46 to 1.64

Table 2. Calcium carbonate, pH, ECe, ionic composition of saturation extract and SAR of soils of Aligarh.

	Name of the village	Free $CaCO_3$ (%)	pH	ECe (dS/m)	Cations (me/l) $Ca^{2+} + Mg^{2+}$	K^+	Na^+	Anions (me/l) $CO_3^{-} + HCO_3^-$	Cl^-	SO_4^{-}	SAR
1	Atalpur	0.80	8.20	1.20	4.8	0.20	7.00	3.0	3.4	5.6	4.52
2	Balampur	0.85	7.88	2.20	6.3	0.46	15.24	4.4	2.7	14.9	8.59
3	Bhojaka	1.42	7.70	2.10	5.6	0.44	14.96	5.2	2.6	14.2	8.94
4	Diwa Hamidpur	1.12	7.90	1.70	5.4	0.23	11.37	2.8	3.8	10.4	6.92
5	Ganeshpur	0.95	8.40	1.60	5.0	0.25	10.75	5.0	5.0	6.0	6.80
6	Girdharpur	0.75	8.00	0.90	4.6	0.31	4.09	4.9	1.6	2.5	2.70
7	Hardaspur	0.92	8.10	1.40	5.6	0.23	8.17	3.7	3.8	6.5	4.88
8	Havibpur	0.98	7.72	1.10	5.9	0.32	4.78	2.5	1.5	7.0	2.78
9	Kajrauth	0.82	7.10	0.80	3.0	0.38	4.62	3.0	2.0	3.0	3.77
10	Kalyanpur Rani	0.95	8.09	1.10	6.0	0.13	4.87	3.0	2.0	6.0	2.81
11	Karsua	1.25	8.20	1.50	6.0	0.25	8.75	4.0	4.0	7.0	5.05
12	Lhosara	1.60	8.20	1.20	4.8	0.20	7.00	3.2	3.2	5.6	4.52
13	Lodha	1.00	8.30	1.30	5.2	0.21	7.59	3.4	3.4	6.2	4.71
14	Pali	0.95	7.30	1.10	4.4	0.35	5.25	2.7	2.7	4.6	3.54
15	Prempur	2.25	7.89	2.40	7.0	0.51	16.49	5.0	3.0	16.0	8.81
16	Rajpur	1.20	7.70	1.60	5.2	0.22	10.58	2.6	3.5	9.90	6.56
17	Resari	1.65	7.60	1.80	6.0	0.25	11.75	3.0	4.0	11.0	6.78
18	Rooppur	1.15	7.80	1.50	4.8	0.20	10.00	2.5	3.2	9.3	6.45
19	Shadipur	2.12	7.88	2.30	6.4	0.48	16.12	4.8	2.8	15.4	9.01
20	Umari	0.90	8.30	1.40	4.4	0.21	9.39	4.3	4.3	5.4	6.33

g/cc with an average of 1.52 g/cc. Soils of six villages namely Balampur, Bhojaka, Kajrauth, Pali, Prempur and Shadipur having bulk density less than 1.50 g/cc. While two villages Ganeshpur and Havibpur showed bulk density more than 1.60 g/cc. The particle density of the soils of Aligarh district was found in the range of 2.56 to 2.72 g/cc. Average particle density for whole district was 2.65 g/cc. The reason for high densities might be due to the presence of low organic matter in the soils. Porosity of study area ranged from 39.7 to 43.9% with an average of 42.6%. Lowest and highest pore space was recorded in Ganeshpur and Pali village soils. Out of twenty villages, soils of nine villages contain 43% or more porosity, while rest eleven villages contain less than 43% pore space.

Calcium Carbonate

Free calcium carbonate content of the soils varied from 0.75 to 2.25% with an average of 1.18% (Table 2). Out of 20 villages ten villages contains less than 1% $CaCO_3$, while rest ten villages having 1 or more than 1% $CaCO_3$. Minimum (0.75%) and maximum (2.25%) calcium carbonate was reported in the soils of Girdharpur and Prempur villages, respectively.

Soil Reaction

The pH value of the soils ranged from 7.10 to 8.40 with an average of 7.91 which indicating that soils are alkaline in reaction. Out of twenty villages soils of Atalpur, Ganeshpur, Hardaspur, Kalyanpur Rani, Karsua, Lchosara, Lodha and Umari had pH more than 8.00. The percentage of soil samples occupied slightly alkaline and moderately alkaline categories were 60 and 40 respectively.

Electrical Conductivity of Saturated Extract (ECe)

The electrical conductivity of saturation extract (ECe) ranged from 0.80 to 2.40 dS/m with an average of 1.51 dS/m. Most of the soil samples of different villages possessed ECe 1—2 dS/m. The sample collected from Balampur, Bhojaka, Prempur and Shadipur villages have ECe more than 2 dS/m. While the soil samples collected from Girdharpur and Kajrauth villages have ECe less than 1 dS/m. Similar results have also been responded by Sharma and Pal (5).

Ionic Composition of Saturation Extract

The cationic composition of the saturation ex-

tract for most of the villages was Na – Ca + Mg – K type, which indicate that Na^+ was dominant cation in saturated extract. However, Ca + Mg – Na - K type cationic composition was noted in soils of Havibpur and Kalyampur Rani villages. The anionic composition of saturation extract was $SO_4 – Co_3 + HCO_3 – Cl$ type for most of soil samples. But soils of Girdharpur had $Co_3 + HCO_3 – SO_4 – Cl$ type anionic composition. Mean concentration of $CO_3 + HCO_3$ and Cl ions were almost equal in saturated extract.

Sodium Adsorption Ratio

Sodium adsorption ration (SAR) of the soils ranged from 2.70 to 9.01 with a mean value of 5.72. Minimum and maximum SAR values were noted in soils of Girdharpur and Shadipur villages, respectively. All soil samples of surveyed fields were alkaline in reaction but none of soil sample was found sodic.

Conclusion

The results show that soils of Aligarh district are low in organic carbon and available nitrogen. However, the soils of the study area are medium in available phosphorus and potassium. Bulk density and particle density of the soils are towards high limit might be due to low organic carbon status of the soils. Alkalinity and salinity are also associated with soils, but soluble salt and sodium accumulation in the cultivated soils is quite low.

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