Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(2): 1445-1448
Received: 11-01-2019
Accepted: 14-02-2019

Sandip Kumar Gupta
Department of Agricultural Chemistry & Soil Science, SMM Town PG College, Ballia, Uttar Pradesh, India

Ashok Kumar Singh
Associate Professor, Department of Agricultural Chemistry & Soil Science, SMM Town PG College, Ballia, Uttar Pradesh, India

Anil Kumar Singh
Assistant Professor, Department of Agricultural Chemistry & Soil Science, SMM Town PG College, Ballia, Uttar Pradesh, India

Ashish Ranjan
Department of Agricultural Chemistry & Soil Science, SMM Town PG College, Ballia, Uttar Pradesh, India

Naveen Kumar Shukla
Department of Agricultural Chemistry & Soil Science, SMM Town PG College, Ballia, Uttar Pradesh, India

Correspondence
Anil Kumar Singh
Assistant Professor, Department of Agricultural Chemistry & Soil Science, SMM Town PG College, Ballia, Uttar Pradesh, India

Physico-chemical characterization of soils of Bairia block of district Ballia, Uttar Pradesh

Sandip Kumar Gupta, Ashok Kumar Singh, Anil Kumar Singh, Ashish Ranjan and Naveen Kumar Shukla

Abstract
An investigation was carried out for characterization of soils of Bairia block of Ballia district, (UP) India. Depth wise soil samples were collected from two pedons selected in two villages. For this purpose, a soil profile was opened in each village. Soil samples were collected from various soil depth viz. 0-15, 15-30, 30-45, 45-60, 60-75, 75-90, 90-105, 105-120, 120-135 and 135-160 cm. Standard analytical methods and procedures were followed for analysis of physico-chemical parameters of soils. Results revealed that pH of soil found to be neutral to slightly alkaline whereas EC was recorded in normal range. Organic carbon content in soil varied from 1.62 to 0.12%. The soil of study area was slightly to moderately calcareous in nature with 1.85 to 3.12% calcium carbonate. Available nitrogen, phosphorus, potash and sulphur content in soil varied from 360.60 to15.70 kg ha^{-1}, 14.50 to 5.30 kg ha^{-1}, 393.40 to 212.80 kg ha^{-1} and 12.00 to 5.80 kg ha^{-1}, respectively. The texture of soil was found to be loamy sand to silty loam.

Keywords: Pedon, soil organic carbon, soil depth and NPKS content

Introduction
The soil is the most vital and precious natural resource that sustains all kind of life on the earth. The indigenous ability of soils to supply sufficient amount of essential nutrients has decreased with higher plant productivity levels associated with increased human demand for food. Therefore, one of the greatest challenge today for every stakeholder of agriculture is to develop and implement such soil, crop and nutrients management technologies that could enhances the plant productivity and also improve the quality of soil, water and air. If we do not improve the productive capacity of our delicate soils, we cannot continue to support the food and fibber urging of our ever-growing population (Choudhury, 2017) [2].
Singer and Ewing (2000) [13] stated that "useful evaluation of soil quality is a required agreement about why soil quality is important, how it is defined, how it should be measured, and how to respond to measurements with management, restoration, or conservation practices". Determining soil quality requires one or more value judgments and because there is still much unknown about soil which may have direct bearing on the crop production level. Some of the physical (soil texture, bulk density, particle density, porosity, rooting depth, colour, hydraulic conductivity, infiltration rate, water holding capacity, soil water retention curve and water stable aggregate, etc.), chemical (pH, EC, SOC, CaCO3, exchangeable cations and anions, CEC, ESP, SAR, macro and micro nutrients) and biological (soil microbial biomass, soil dehydrogenase and phosphatase enzyme activity) parameters which control the soil quality (Lal, 2004) [5]. Soil test-based fertility management is an effective tool for increasing productivity of agricultural soils that have a high degree of spatial variability resulting from the combined effects of physical, chemical or biological processes (Govaerts, 1998). However, In India, prevalence of small holding systems of farming as well as the lack of infrastructural facilities are the major constraints for extensive soil testing (Sen *et al*., 2008) [12]. It is established fact that for optimum and sustainable utilization of soil resource, its systematic characterization is prerequisite. Therefore, the present investigation was undertaken for characterization of soil morphological and other related physical, chemical properties of selected pedons and status of soil fertility parameters for soils of district Ballia.

Materials and Methods
Ballia district, the eastern part of the state of Uttar Pradesh is situated in central portion of the Ganges basin. The geographical extent of the district lies between latitude from 25°23" to 26°11" north and at longitudes from 83°38" to 84°39" east with elevation of about 27 to 115 meters above the sea level. The mean annual rainfall ranges from 950 to 1150 mm. The district has an area of 1,981 sq. km and 3,223,642 populations.

The area truly represents the agronomical conditions of north east alluvial plains. The relative humidity is generally high during the south west monsoon, being 70%. Soil samples were air dried in shade and powdered gently with a wooden mallet and passed through 2 mm sieve. Soil pH was determined in 1:2.5 soil water suspension using glass electrode. Electrical conductivity (EC) was determined in 1:2.5 soil-water extract using Conductivity Bridge and expressed as dSm^{-1} (Jackson, 1967). Calcium carbonate ($CaCO_3$) was determined by rapid titration method (Puri, 1930) [10]. Organic carbon (OC) was determined by rapid titration method (Walkley and Black, 1934) [18]. Available nitrogen (N) was determined by alkali extractable nitrogen method (Subbiah and Asija, 1956) [16], available phosphorus (P) by Olsen *et al*., (1954) and available potash (K) through a flame photometer after extraction with ammonium acetate (Hanway and Heidel, 1952) [3]. Available sulphur (S) was extracted using 0.15 per cent calcium chloride solution (Williams and Steinbergs, 1969).

Result and Discussion

Soil pH and EC

The soil pH data of both pedons presented in table 1. The increasing trend of pH was observed with the increasing the soil depth which was slightly alkaline at the lower depth irrespective of the pedons. Pedon-1 showed 7.3 pH at 0-15 cm whereas it was 7.6 at 135-160 cm soil depth. pH of pedon-2 soils ranged between 7.2 to7.9. The higher biological activities might be responsible for optimum pH range on surface soil. The pH value increased with increasing the depth of soil might be attributed to neutral soluble salt (Abrol, 1998). The lower layer of soil had higher pH values may also be due to salts retained by clay particles or as a result of chemical precipitation. Further data revealed that the EC of soil under study ranged from 0.994 to1.02 dSm^{-1}. The EC increased slightly with increasing soil depth in both pedons. The normal EC may be ascribed to leaching of salts to lower horizons might be due to the light textured nature of the soil. All the horizons found to be in safe EC range as far as crop growth and development concerned.

Organic Carbon

Data on the organic carbon (table-1) showed that the soil organic carbon content decreased with increasing pedons depth. Cereals based cropping system soil contained higher range of organic carbon. Organic carbon content in surface soil (0-15 cm) of pedon-1 was observed 1.62% and in sub surface soil (135-160 cm) 0.12% whereas in Pedon 2 organic carbon found to be 1.18% in surface soil and 0.16% in sub surface soil. Both pedons showed high to low range of organic carbon content. The greater amount of organic carbon in surface soil might be due to direct addition of organic matter and accumulation of organic substrates. The similar finding was reported by Sahu and Bala (1995) [11].

Calcium Carbonate

Calcium carbonate content varied between 1.85 to 3.12% in the soils of the both pedons (Table1). Pedon-1 had greater amount of calcium carbonate 3.10% at 60-75 cm soil depth and minimum amount of calcium carbonate 1.95% at 45-60 cm. Pedon-2 showed maximum calcium carbonate 3.12% (60-75 cm) whereas minimum 1.85% (120-135 cm) soil depth. The amount of calcium carbonate did not follow any regular trend in both the pedons. The distribution of $CaCO_3$ in both the pedons was irregular which might be due to the dynamic of salt movement.

Available Nitrogen

Data pertaining to available nitrogen is presented in table 2. Available N content decreased with increasing the soil depth irrespective the pedons. Mineralizable N content in pedon-1 was found to be maximum 360.6 kg ha^{-1} in surface horizon (0-15 cm) and minimum 15.7 kg ha^{-1} was recorded in lower horizon (135-160 cm). Pedon-2 showed maximum available N 266.6 kg ha^{-1} in surface horizon (0-15 cm) whereas minimum 37.6 kg ha^{-1} in lower horizon (135-160 cm). The increase in available N content in surface soil might be possible due to the accumulation of natural vegetation residues and organic materials. It might be there where more microbial transformation due to moisture content (Prasuna Rani *et al*. 1992). Similarly, Singh *et al* (2011) [14] also reported in a study from Darjeeling soil that the status of available N was higher in top soil compared to sub soil.

Available Phosphorus

Depth wise distribution of available P in soils of both pedons presented in table 2. The available P content varied between 14.56 to 5.37 kg ha^{-1} in pedons which decreased regularly with increasing soil depth. Available P content in pedon-1 was found to be maximum (14.56 kg ha^{-1}) in surface horizon (0-15 cm) and minimum (9.46 kg ha^{-1}) in sub-surface horizon (120-135). In the pedon-2 available P varied from 9.86 kg ha^{-1} in surface horizon (0-15 cm) and minimum 5.37 kg ha^{-1} in lower horizon. Greater available P was observed in the surface horizons and decreased irregularly with depth. It was attributed might be due to supplementation of the depleted P through external fertilizer sources and land use system (Thangaswamy *et al*. 2005) [17].

Available Potassium

Data on available K (table-2) revealed that the available K content in soils of both the pedons ranged from 393.4 to 212.8 kg ha^{-1}. The available K content in pedon-1was found to be 392.0 kg ha^{-1} at 45-60 cm horizon depth and 235.2 kg ha^{-1} at 120-135 cm horizon depth. The pedon-2 showed maximum K 393.4 kg ha^{-1} at 30-45 cm soil depth whereas minimum K 212.8 kg ha^{-1} at 135-160 cm soil depth. The amount of available K did not show any regular trend irrespective of the pedons. It could be attributed to more intensive weathering and release of exchangeable K and decomposition from organic residues. However, Singh *et al.* (2017) [15] reported that available K was higher in top soil than sub soil.

Available Sulphur

The available S content varied with the horizon depth depending upon soil pH and organic carbon of soils of both pedons of various land use system. Available S in surface soil (0-15cm) in pedon-1was 11.6 mg kg^{-1} whereas it was 7.4 mg kg^{-1} in lower horizon. Pedon-2 showed 12.0 to 5.8 mg kg^{-1} S. Higher amount of available S was found in surface soil than sub surface soil resulted from its recycling over the years by plant and subsequent organic matter accumulation (Bhatnagar *et al.* 2003) [1].

Exchangeable Ca and Mg [cmol (P^+) kg^{-1}]

The data of exchangeable Ca and Mg depicted in fig.1. Maximum Ca content in pedon-1 was 18.4 (0-15 cm) and minimum 11.9 (135-160 cm) was in lower horizon whereas in pedon-2 Ca varied from 7.0 (0-15 cm) to 5.4 (135-160 cm).

The magnitude of Ca level in pedon-1 might be greater due to submerged soil retained high clay content regarding their depth. The exchangeable Ca might be associated with clay, phosphorus and carbon to develop hardness and compactness of soil. (Nozirkar and Sonar, 1991; Divakar and Singh 1993) [6]. The amount of exchangeable Mg in pedon-1 found to be greater 14.6 at (0-15 cm) surface soil and minimum 12.0 at (45-60 cm) soils depth whereas pedon-2 showed maximum 10.0 at (30-45 cm) soils depth and minimum 1.2 at (120-135 cm) soils depth. Exchangeable Mg content in the waterlogged soil area was lesser than that of double cropping area of pedon-1 due to recycling in rhizosphere. The similar finding given by Vishrteresky and Steinberger (1997).

Table 1: Status of soil pH, EC, Organic Carbon and $CaCO_3$ of pedons

Soil Depth (cm)	Sripalpura (Pedon-1)				Tiwari ke Millikee (Pedon-2)			
	pH (1:2.5)	EC (dSm^{-1})	O. C. (%)	$CaCO_3$ (%)	pH (1:2.5)	EC (dSm^{-1})	O. C. (%)	$CaCO_3$ (%)
0-15	7.3	0.994	1.62	2.63	7.2	1.001	1.18	2.47
15-30	7.3	0.998	1.11	2.67	7.2	0.999	1.01	2.05
30-45	7.4	0.999	0.82	2.45	7.2	1.007	0.83	2.20
45-60	7.4	1.002	0.73	1.95	7.2	1.011	0.44	2.55
60-75	7.5	1.004	0.51	3.10	7.2	1.006	0.42	3.12
75-90	7.5	1.009	0.39	2.65	7.3	1.002	0.34	2.70
90-105	7.5	1.012	0.35	2.85	7.4	1.005	0.29	2.83
105-120	7.6	1.019	0.28	2.40	7.7	1.009	0.25	2.22
120-135	7.6	1.021	0.19	2.28	7.8	1.011	0.22	1.85
135-160	7.6	1.021	0.12	2.52	7.9	1.016	0.16	1.98

Table 2: Status of available NPK and S in pedons soils at different depth

Soil Depth (cm)	Sripalpura (Pedon-1)				Tiwari ke Millikee (Pedon-2)			
	N (kg ha^{-1})	P_2O_5 (kg ha^{-1})	K_2O (kg ha^{-1})	S (mg kg^{-1})	N (kg ha^{-1})	P_2O_5 (kg ha^{-1})	K_2O (kg ha^{-1})	S (mg kg^{-1})
0-15	360.60	14.56	324.80	11.60	266.60	9.86	348.00	12.00
15-30	250.90	14.20	279.20	10.80	244.50	8.51	370.20	11.20
30-45	181.20	11.72	268.00	10.20	188.20	7.17	393.40	10.70
45-60	166.30	12.24	312.20	9.60	100.40	7.62	381.20	10.60
60-75	112.90	10.84	246.40	8.40	94.10	7.13	358.40	9.60
75-90	98.70	12.84	268.80	8.80	78.50	6.72	235.20	8.80
90-105	87.90	11.45	235.20	8.60	59.70	6.72	313.60	8.60
105-120	47.10	12.14	268.40	7.40	51.20	5.37	257.60	7.20
120-135	37.90	9.46	224.60	6.80	48.50	7.16	280.00	6.40
135-160	15.70	10.64	216.20	6.60	37.40	5.37	212.80	5.80

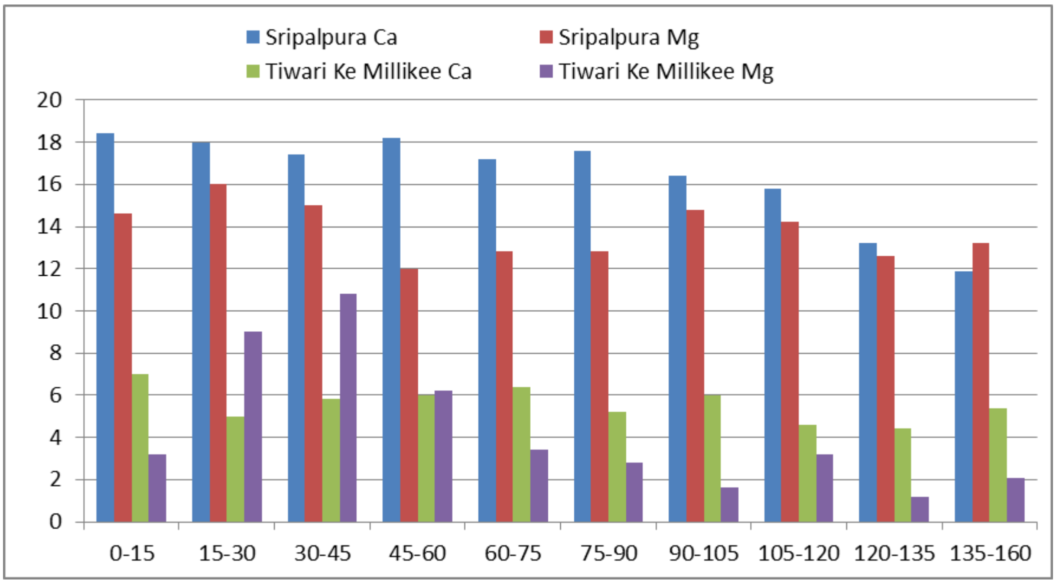

Fig 1: Exchangeable Ca and Mg content in soils of pedons at different depth.

References

1. Bhatnagar AK, Bansal KN, Trivedi SK. Distribution of sulphur in some profiles of Shivpuri District of Madhya Pradesh. Journal of the Indian Society of Soil Science. 2003; 51:74-76.
2. Choudhury S. Soil fertility status of paddy and sugarcane growing areas of village Butlaw and Dabhalia of Navsari district. M.Sc.(Ag.) Thesis, NAU, Navsari, Gujrat, 2017.
3. Hanway J, Heidel H. Soil analysis as used in Lowa state college Testing Laboratory, Ames. Lowa, 1952.
4. Jackson ML. Soil Chemical Analysis, Prentice Hall of India Private Limited, New Delhi, 1973.

5. Lal R. Methods and guidelines for assessing sustainability use of soil and water resources in the topics. Scientific Publishers, Jodhpur, 2004, 290.
6. Nozirkar RB, Sonar SP. Calibration of soil test methods for available N in black soil (in captiols). Journal of the Indian Society of Soil Science. 1991; 37:383-385.
7. Olsen SR, Cole CV, Watanable FS, Dean LA. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. United States Department of Agriculture Circular 939, Washington, 19, 1954.
8. Parsuram S, Jayraj S. Distribution of total and available N, P and K of the major soil series of profiles of black soils of Coimbatore district, Tamil Nadu. Madras Agricultural Journal. 1982; 69:825-829.
9. Power JF, Meyers RJK, The maintenance or improvement of farming systems in North America and Australia. In: Stewart, J.W.B. (ed.): Soil quality in semi-arid agriculture. In: Proc. Int. Conf. Univ. Saskatchewan, Saskatoon, Canada. 1989, 273–292.
10. Puri AN. A new method for estimating total carbonates in soils. Imp. Agric. Res. Pusa Bull, 1930, 7.
11. Sahu GC, Bala N. Characterization and classification of soil on valley plains of middle Andman island. Journal of the Indian Society of Soil Science. 1995; 43(1):99-103.
12. Sen P, Majumdar K, Sulewski, G. Importance of spatial nutrient variability mapping to facilitate SSNM in small land holding systems. Indian J Fertilizer. 2008; 4(11):43-50.
13. Singer MJ, Ewing SA. Soil quality. In: Sumner, M.E. (ed.): Handbook of Soil Science. CRC Press, Inc., Boca Raton, FL. 2000, 271-298.
14. Singh AK, Bisen JS, Bora DK, Kumar R, Bera B. Comparative study of organic, inorganic and integrated plant nutrient supply on the yield of Darjeeling tea and soil health. Two and a Bud. 2011; 58:58-61.
15. Singh AK, Pathak SK. Potassium in tea soil (*Camellia sinensis* (L) O. Kuntze) cultivation from soil to cup quality-A review. Agricultural Reviews. 2017; 39(1):219-227.
16. Subbiah BV, Asija GL. A rapid method for the estimation of available nitrogen in soils. Current Science. 1956; 25:259.
17. Thangaswamy A, Naidu MVS, Ramavatharan M, Raghavreddy C. Characterization classification and evaluation soil resources sivagin micro watershed of Chittur District in Andhra Pradesh for sustainable land planning. Journal of the Indian Society of Soil Science. 2005; 53:11-21.
18. Walkley A, Black IA. An examination of the direct of method for determining soil organic matter and a proposed modification of titration method. Soil Science. 1934; 34:29-38.
19. Williams CH, Steinbergs A. Soil sulphur fractions as chemical indices of available sulphur in some Australian soils. Australian Journal of Agricultural Research. 1959; 10:340-352.