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1. ASSESMENT OF PHYSICO-CHEMICAL PROPERTIESIN SOILS OF SAMASTIPUR ANDMUZAFFARPURDISTRICTOFBIHAR,INDIA.

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AUTHORS

RAHULKUMAR[1],

Email-rk258136@gmail.com

Contact- +91-7976244237

M.Sc. Scholar, SOIL SCIENCE AND AGRICULTURAL CHEMISTRY, Naini Agricultural institute, SHUATS, Prayagraj Uttar Pradesh, India.

Corresponding author Detail

AmreenHasan

Department of Soil Science and Agriculture Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj-211008 (UP), India.

Email: amreenhasan@gmail.com

ORCID: https://orcid.org/0000-0001-9625-1024

Tarence Thomas

Department of Soil Science and Agriculture Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj-211008 (UP), India.

Email: tarence.thomas@shiats.edu.in

Arun Alfred David

Department of Soil Science and Agriculture Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj-211008 (UP), India.

Email:arun.david@shuats.edu.in

IskaSrinath Reddy

Department of Soil Science and Agriculture Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj-211008 (UP), India.

Email: iskasrinathreddy@gmail.com

ORCID:

Author Contribution

2. ABSTRACT

The present study was carried out in the Soil Science and Agricultural Chemistry lab at Sam Higginbottom University of Agriculture Technology and Sciences.The sampling location was Samastipur and Muzaffarpur distric of Bihar..The objective of the study was to analyse the Physico-chemical properties in soils of Samastipur and Muzaffarpur district of Bihar, India. Depthwise soil

samples were collected from nine different village of 3 blocks of selected spots at0-15,15-30and30-45cm.The total no of 27 samples were collected from several farmer's fields, and composite sampling was carried out . The results revealed that the texture of the soils varied from sandy loam to sandy clay loam with majority of them falling under sandy loam textural class The bulk density ranged from 1.02 to 1.42 (Av. 1.18) (Mg m^{-3}), particle density from 2.30 to 2.66 (Av 2.51) (Mg m^{-3}), pore space from 42.74 to 58.87 (Av. 52.93)(%), water holding capacity from 40.70 to 70.50 (Av.54.86)(%), specific gravity from 1.90to2.41(Av.2.22).ThepHrangedfrom7.23to9.21(Av.8.04),E.C.rangedfrom0.32to 1.45 (Av. 0.74) (dS m^{-1}). The soil organic carbon ranged from 0.22 to 0.76 (Av. 0.43) (%).Available nitrogen ranged from250.9to315.82(Av.283.86)(kgha^{-1}),available phosphorous ranged from 29.32 to 50.23 (Av. 35.72) (kg ha^{-1}) ,available potassium rangedfrom89.20to180.20(Av.128.94)(kgha^{-1}),freecalciumcarbonaterangedfrom20.21to 36.82(Av. 27.88)(%), available sulphur ranged from13.28 to38.23 (Av.18.24)(ppm).The Soil has acceptable BD, PD, pore space, and water holding capacity. As a result of the beneficial electrical conductivity for plants, the pH of the soil is neutral to alkaline. Nitrogen, Phosphorus, Potassium, and Available Sulphur are low to medium in macronutrients. The results indicated that overall soils were in moderate conditions and farmers required maintaining soil health card, adopting suitable management practices and providing proper nutrition to the soil to overcome the pollution effect.

Keywords: Samastipur ,Muzaffarpur ,SoilPhysico-chemicalproperties,depth,Nutrients,*etc*.

3. INTRODUCTION

Soil health is the ‒state of the soil being in sound physical, chemical, and biological condition, having the capability to sustain the growth of plants‖ (Idowu *et al.,*2019). Optimal physical and chemical soil properties will lead to optimal soil biological properties and ideal soil health and productivity (Soil Health Nexus, 2021). Healthy soils constitute the foundation of thriving ecosystems and societies and are directly tied to food and nutritional security, water quality, human health, climate change mitigation/adaptation, and biodiversity (Manter*et al.,* 2017). Recent media headlines state that‒Healthy soils lead to healthy food, ‖suggestingthatSoilhealthpracticeswill‒producecropsthatcontainmorenutrientsforhumanstoconsume‖(Latzke,2020).The soil health and quality has consistently evolved with an increase in the understanding of soil and soil quality attributes (Chaudhary *et al.,* 2012). In soil-based agriculture, soil health is the most important foundation of a healthy farm ecosystem. Yet most of the common farming techniques

employed in industrial crop production, such as synthetic fertilizer application and mono-cropping, can degrade soil over time, causing a cascadeofproblemsnecessitatingtheuseofevenmoreman-madeinputswhichinturncontribute to climate change (Food print.org, 2021). Yield outcomes of Soil Health management are of importance to ensure that future global food demands are met (VanIttersum*et al.*, 2013). Improvements in Soil health via good management can promote crop yields in systems where nutrients or water are limiting via increased nutrient cycling, nutrient availability, and/or water capture (Foley *et al.*, 2011). Management practices posited to improve Soil health (*i.e.*, no-till, residue retention, cover crops, rotation) can influence both abiotic and biotic yield components, with subsequent positive, negative, or neutral yield impacts (Miner *et al.*, 2020). Four principles have been promoted for maximizing Soil health:(a) minimize disturbance (no-till),(b) maximize plant diversity,(c) maintain living roots throughout the year, and (d) maximize soil coverage (USDA-NRCS, 2019. The industrialization and development in agriculture are necessary to meet the basic requirement of people, at the same time it is necessary to preserve the environment (Bansal *et al.*, 2016). For the high crop yield the farmers used the pesticides and fertilizers in excess amount causes serious environmental problems and also consider their possible impact on soil health. Nitrogen, phosphorus and potassium ratioisan important indicator in crop production that identifies balanced and unbalanced fertilization. Hence, balanced fertilizer application are important for high crop yield (John*etal.*,2010). The food productivity and environmental quality is dependent on the Physico-chemical properties of soil, so it isvery important to know the basic knowledge about the Physico-chemical properties of soil (Tale*et al.*, 2015).

MATERIALS AND METHOD

Experimental site:

Bihar is located on the Gangetic Plain, which is the world's most fertile alluvial plain. Longitude 83°-19'-50" 88°-17'-40" E, latitude 24°-20'-10" 27°-31'-15" N. The experimental sites include the cultivation field of two different districts of Bihar statei.e., Samastipur and Muzaffarpur

1. Samastipur:-

The district of Samastipur is located in North Bihar and is bordered on the northby the Bagmati river, which divides it from Darbhanga district, on the west by Vaishaliand some parts of Muzaffarpur districts, on the south by the Ganges, and on the east by Begusarai and some parts of Khagaria districts. The district covers a region of 2624.82 square kilometres and is located between25^0 46' - 26^0 05' N

latitudes and $85^0$10' - 86^0 23' E longitudes. It is situated at mean sea level of 52.18 metres.

Muzaffarpur:-

Being an important district of Bihar, Muzaffarpur is situated at north of ganga. Ithas a 3132 km^2 geographical range and located between 25^0 04' - 26^0 07' N latitude and84053'-$85^0$45'E longitude and is situated at 70meters above mean sea level. Muzaffarpur district is surrounded by Sitamarhi, East Champaran, Vaishali, Saran and Darbhangadistrict.

Soil samples were collected from 9 different village of Samastipur and Muzaffarpur district. Soil samples were collected from each farmer‘s field after harvest or before sowing. Three different sites were taken in each farmer‘s field represented three profile depths viz., 0-15 cm, 15-30 cm and 30- 45 cm, totally 27 samples were collected with 9 samples representing one farmer‘s field. At sampling site, soil samples were collected separately by a random selection from field with help of khurpi, spade, digging bar and meter scale. Samples were collected from centre of the fields in order to avoid the edge effect. Each soil sample is about 500mg collected from the 0–15 cm layer (which represented the plough layer), 15-30cm and 30-45cm depth.

Analysis of physico-chemical parameters

Soil textural analysis of particles less than 2 mm was performed by the hydrometer method (Bouyoucos, 1927) (4) . The bulk density, particle density, pore space and water holding capacity was determined by the graduated 100 ml measuring cylinder method (Muthuvel et al., 1992) (14) . Specific gravity of soil was determined by the relative density bottle or pycnometer method as laid out by Black (1965) (3) . The pH was determined by1:2.5 soil water suspension method using digital pH meter (Jackson, 1958) (11) . EC was determined by1:2 soil-water suspension method using digital EC meter (Wilcox, 1950) (29) . Organic carbon was determined by the wet oxidation method (Walkley and Black, 1947)(27) . Available N was determined by alkaline potassium permanganate method (Subbiah and Asija, 1956) (21) . Available P was determined by colorimetric method (Olsen et al., 1954) (16) . Available K was determined by flame photometer method (Toth and Prince, 1949) (25) . Exchangeable calcium and magnesium was determined by neutral ammonium acetate extraction method or EDTA method (Cheng and Bray, 1951) (5) . Available S was determined by turbidimetric method (Bardsley and Lancaster, 1960)

Statistical analysis

The data recorded during the course of investigation was subjected to statistical analysis by the method of analysis of variance (ANOVA) technique (Fisher, 1960) (6). The type of ANOVA adopted for the experiment was two-factor analysis without replication. The implemented design of experiment in the analysis done was Completely Randomized Design (CRD). It is used when experimental units are homogenous as it involves only two basic principles of the design of experiment, viz., replication and randomization. CRD is used for laboratory purpose only. The significant and non-significant treatment effects were judged on the basis of ‗F'(variance ratio) test.

Result and Discussion

Variation in Physical properties of Samastipur and Muzaffarpur district at different depth.

The texture of these soils varied from sandy loam to sandy clay loam with majority of them falling undersand yloamtextural class. The sand, silt and clay contents ranged between48.30 to 76.93 (Av. 65.43) per cent, 8.86 to 35.59 (Av. 17.79) per cent, 6.87 to 25.06(Av.16.78) percent, respectively. .The bulk density ranged from 1.02 to 1.42 (Av 1.18) (Mg m^{-3}). The maximum value is 1.42 (Mg m^{-3}) which is found in two depth of B_2V_2 at (15-30) and (30-45 cm depth) and the minimum value found in B_3V_1(15-30 cm depth)1.02 (Mg m^{-3}). The particle density ranged from 2.30 to 2.66 (Av 2.51)(Mg m^{-3}). The maximum value found in B_3V_2(15-30 cm depth) 2.66 (Mg m^{-3}) and the minimum value found in B_2V_3(30-45 cm depth) 2.30 (Mg m^{-3}) . The pore space (%) ranged from 42.74 to 58.87(Av 52.93)(%). The maximum value found in B_3V_1(15-30 cm depth)58.87 (%) and the minimum value found in B_2V_2(15-30 cm depth) 42.74(%).The water holding capacity (%) ranged from 40.7 to 70.5(Av60.47) (%). The maximum value found in B_1V_3(0-15 cm depth) 780.5 (%) and the minimum value found in B_3V_1(0-15cm depth) 40.7(%).The specific gravity ranged from 1.9 to 2.41 (Av 2.22) The maximum value found inB_2V_3 (15-30 cm depth) 2.41 and the minimum value found in B_3V_3(30-45 cm depth) 1.9.

Variation in Chemical properties of Samastipur and Muzaffarpur district at different depth.

The pH ranged from 7.23 to 9.21 (Av 8.04). The maximum value found in B_1V_3 (15-30 cm depth) 9.21 and the minimum value found in B_3V_1 (0-15 cm depth) 7.23, thereby indicating the soils are moderately alkaline . The electrical conductivity ranged from 0.32 to 1.45 (Av0.74) dS m^{-1}. The maximum value found in B_2V_2 (30-45 cm depth) 1.45 dS m^{-1} and the minimum value found in B_2V_2 (0-15 cm depth) 0.32 dS m^{-1}. It indicates that these soils vary in their reaction from moderately to strongly alkaline and most of them are strongly alkaline The soil organic carbon (%) ranged from 0.22 to 0.76(Av0.43) (%). The maximum value found in B_3V_1 (30-45 cm depth) 0.76 (%) and the minimum value found in B_1V_1 (0-15 cm depth) 0.22 (%).The available nitrogen (kg ha^{-1}) ranged from 250.9 to 315.82 (Av. 283.86) (kg ha^{-1}). The maximum value found in B_2V_1 (30-45 cm depth) 315.82 (kg ha^{-1}) and the minimum value found in B_1V_1 (0-15 cm depth) 250.90 (kg ha^{-1}). The available phosphorous (kg ha^{-1}) ranged from 29.32 to 50.23 (Av. 35.72) (kg ha^{-1}). The maximum value found in B_3V_3 (30-45 cm depth) 50.23 (kg ha^{-1}) and the minimum value found in B_1V_1 (0-15 cm depth) 29.32 (kg ha^{-1}). The available potassium (kg ha^{-1}) ranged from 89.2 to 180.2 (Av. 128.94) (kg ha^{-1}). The maximum value found in B_3V_1 (0-15 cm depth) 180.2 (kg ha^{-1}) and the minimum value found in B_2V_2 (0-15 cm depth) 89.20 (kg ha^{-1}).The free calcium carbonate (%) ranged from 20.21 t0 36.82(Av.27.88) %. The maximum value found in B_1V_3 (30-45 cm depth) 36.82 % and the minimum value found in B_3V_3(15-30 cm depth) 20.21 %.The available sulphur (ppm) ranged from 13.28 to 38.23 (Av.18.24) (ppm). The maximum value found inB_2V_2 (30-45 cm depth) 38.23 (ppm) and the minimum value found inB_1V_1 (0-15 cm depth) 13.28 (ppm).

Conclusion

It is concluded from the trial that the soils of Samastipur and Muzaffarpur district village are sandy loam with adequate BD, PD and pore space. It is neutral to alkaline as favorable electrical conductivity for plant growth, fertile with high organic content and low to medium of macronutrients *viz.* nitrogen, phosphorous and potassium. The deficiency of the nutrients can be mitigated by the use of organic and inorganic fertilizers.

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Table 1: **Representing the Sampling site of Samastipur and Muzaffarpur District**

Sl. No.	Block's name(B)	Name of the Villages(V)	Latitude(N^0)	Longitude (E^0)
1	PUSA(Samastipur) (B_1)	V_1-DRPCAU Pusa farm	25º60′50.09″	85º40 ′ 28.31 ″
		V_2-Pusa Bazar	25º59 ′ 42.47 ″	85º39 ′ 35.07 ″
		V_3-Birauli	25º56 ′ 35.93 ″	85º46 ′ 30.59 ″
2	TAJPUR(Samastipur) (B_2)	V_1- Baghoni	25º52 ′ 46.05 ″	85º40 ′ 31.13 ″
		V_2-Pusa Road, Quari	25º59 ′ 13.48 ″	85º40 ′ 23.30 ″
		V_3-Hasanpur	25º44 ′ 47.86 ″	86º12 ′ 8.84 ″
3	DHOLI(Muzaffarpur) (B_3)	V_1-Dholi bazar	25º59 ′ 49.85 ″	85º36 ′ 19.37 ″
		V2-Balua	26º11 ′ 6.85 ″	85º37 ′ 51.82 ″
		V_3 -Dholi college	25º59 ′ 43.63 ″	85º35 ′ 39.57 ″

Pusa and Tajpur block comes Samastipur district whereas Dholi block comes under Muzaffarpur district.

Parameters	Methods	Scientist(years)
Texture	BouyoucosHydrometer	Bouyoucos(1927)
ParticleDensity(Mgm^{-3})	Graduatedmeasuringcylinder	Muthuaval*etal*.,(1992)
BulkDensity(Mgm^{-3})		
PoreSpace(%)		
Waterretainingcapacity(%)		
Specific gravity	Pycnometer relative density bottle	Black ,(1965)
SoilpH	DigitalpHmeter	Jackson,(1958)
ElectricalConductivity	DigitalECmeter	Wilcox,(1950)
OrganicCarbon(%)	Wet oxidationmethod	WalkleyandBlack, (1947)
AvailableNitrogen($kgha^{-1}$)	Kjeldahlmethod	Subbaiah,(1956)
AvailablePhosphorous($kgha^{-1}$)	Calorimetricmethod	Olsen*etal*.,(1954)
AvailablePotassium($kgha^{-1}$)	Flamephotometermethod	TothandPrince,(1949)

Free Calcium carbonate	0.5N Sulphuric Acid method	Puri, (1930)
Available Sulphur(ppm)	Turbidimetric method	Bardsley and Lancaster, (1960)

Table 2: Method of Analysis

Table. 3 Assessment of Soil texture of Soil from different depth 0-15, 15-30 and 30-45 cm of Samastipur and Muzaffarpur district

Blocks	Villages	Depth(cm)	%Sand	%Silt	%Clay	Textural class
PUSA	B_1V_1	0-15	64.40	18.80	16.80	Sandy loam
		15-30	65.50	17.80	16.80	Sandy loam
		30-45	66.80	18.90	14.30	Sandy loam
	B_1V_2	0-15	68.90	16.60	14.50	Sandy loam
		15-30	70.10	15.50	14.40	Sandy loam
		30-45	71.50	14.20	14.30	Sandy loam
	B_1V_3	0-15	70.10	15.60	14.30	Sandy loam
		15-30	69.20	16.50	14.30	Sandy loam
		30-45	68.20	15.50	16.30	Sandy loam
TAJPUR	B_2V_1	0-15	66.60	17.80	15.60	Sandy loam
		15-30	66.40	18.20	15.60	Sandy loam
		30-45	65.60	18.80	15.60	Sandy loam
	B_2V_2	0-15	62.60	19.80	17.60	Sandy loam
		15-30	64.60	19.80	15.60	Sandy loam
		30-45	65.50	18.90	15.60	Sandy loam
	B_2V_3	0-15	52.40	34.80	12.80	Sandy clay loam
		15-30	54.60	32.50	12.90	Sandy clay loam
		30-45	53.50	31.90	14.60	Sandy clay loam
DHOLI	B_3V_1	0-15	66.60	17.80	15.60	Sandy loam
		15-30	65.40	16.90	17.70	Sandy loam
		30-45	66.90	16.60	16.50	Sandy loam
	B_3V_2	0-15	48.50	15.10	36.40	Loam
		15-30	49.60	14.80	35.60	Loam
		30-45	47.90	16.10	36.00	Loam
	B_3V_3	0-15	62.30	20.80	12.50	Sandy loam
		15-30	64.60	19.90	15.50	Sandy loam

		30-45	65.90	18.70	14.40	Sandy loam

Table5: Assessment of Physical properties *i.e* Bulk density, Particle density and pore space at different depth 0-15, 15-30 and 30-45 cm of Samastipur and Muzaffarpur district

	Bulk density(Mg m^{-3})			**Particle density(Mg m^{-3})**			**Pore space(%)**		
Treatment/ Farmer's site	**0-15 cm**	**15-30 cm**	**30-45 cm**	**0-15 cm**	**15-30cm**	**30-45 cm**	**0-15 cm**	**15-30 cm**	**30-45 cm**
B_1V_1	1.11	1.23	1.09	65	.64	60	58.11	53.4	58.08
B_1V_2	1.17	1.25	1.25	42	.52	49	51.65	50.39	49.79
B_1V_3	1.06	1.07	1.21	40	.49	52	55.83	57.02	51.98
B_2V_1	1.11	1.05	1.11	32	.39	30	52.15	56.06	51.73
B_2V_2	1.33	1.42	1.42	42	.48	59	45.04	42.74	45.17
B_2V_3	1.05	1.21	1.21	50	.52	52	58.00	51.98	51.98
B_3V_1	1.17	1.02	1.23	49	.48	48	53.01	58.87	50.4
B_3V_2	1.17	1.24	1.26	60	.66	62	55.00	53.38	51.9
B_3V_3	1.25	1.11	1.18	61	.64	65	52.10	57.95	55.47
	F-test	**S.Ed.(±)**	**C.D.@ 0.05%**	**F-test**	**S.Ed.(±)**	**C.D.@ 0.05%**	**F-test**	**S.Ed.(±)**	**C.D.@ 0.05%**
Due to depth	S	0.030551	0.002876	S	0.024853	1.37306	S	0.953299	0.001799
Due to site	NS	0.089241	0.200559	NS	0.097612	0.056611	NS	3.613887	0.339078

Table7 Assessment of Chemical properties *i.e*pH, EC and Organic Carbon gravity at different depth 0-15, 15- 30 and 30-45 cm of Samastipur and Muzaffarpur district

	pH			**EC(Ds m^{-1})**			**Organic carbon (%)**		
Treatment/Farmer's site	**0-15 cm**	**15-30 cm**	**30-45 cm**	**0-15 cm**	**15-30cm**	**30-45 cm**	**0-15 cm**	**15-30 cm**	**30-45 cm**
B_1V_1	8.81	8.32	7.92	0.58	0.59	0.6	0.22	0.23	0.24
B_1V_2	7.42	7.59	7.63	0.61	0.64	0.65	0.32	0.32	0.33
B_1V_3	9.00	9.21	9.18	0.8	0.84	0.96	0.25	0.29	0.31
B_2V_1	7.72	7.52	7.66	0.92	0.98	1.2	0.4	0.42	0.49
B_2V_2	7.82	7.93	7.64	0.32	0.4	0.42	0.6	0.62	0.69

B_2V_3	7.63	7.54	7.62	0.52	0.55	0.62	0.4	0.42	0.48
B_3V_1	7.23	7.32	8.22	0.7	0.72	0.77	0.61	0.62	0.76
B_3V_2	8.01	8.23	8.38	1.1	1.23	1.45	0.42	0.46	0.48
B_3V_3	8.42	8.59	8.69	0.7	0.69	0.68	0.48	0.47	0.49
	F-test	**S.Ed.(±)**	**C.D.@ 0.05%**	**F-test**	**S.Ed.(±)**	**C.D.@ 0.05%**	**F-test**	**S.Ed.(±)**	**C.D.@ 0.05%**
Due to depth	S	0.051452	1.43E-05	S	0.061967	5.22E-10	S	0.03283	0.146884
Due to site	NS	0.554077	0.727608	S	0.266679	0.003151	S	0.146884	0.146884

Table8:: Assessment of Chemical properties *i.e* Nitrogen, Phosphorus and Potassium at different depth 0-15, 15- 30 and 30-45 cm of Samastipur and Muzaffarpur district.

	Nitrogen(Kg ha $^{-1}$)			**Phoshporus(Kg ha $^{-1}$)**			**Potassium(Kg ha $^{-1}$)**		
Treatment/Farmer's site	**0-15 cm**	**15-30 cm**	**30-45 cm**	**0-15 cm**	**15-30cm**	**30-45 cm**	**0-15 cm**	**15-30 cm**	**30-45 cm**
B_1V_1	250.90	252.94	255.94	29.32	30.30	32.40	138.40	139.99	140.22
B_1V_2	260.72	265.79	269.82	30.20	30.80	31.20	140.20	138.20	137.81
B_1V_3	272.80	275.81	276.89	32.40	33.45	34.55	170.80	168.90	162.81
B_2V_1	305.62	310.72	315.82	31.20	32.95	33.45	89.20	90.20	88.00
B_2V_2	292.51	299.7	302.82	31.90	32.60	33.72	89.20	92.20	99.80
B_2V_3	266.72	268.4	272.8	32.80	33.72	34.52	110.20	115.23	120.42
B_3V_1	272.80	275.8	295	34.70	36.72	38.42	115.92	114.20	120.82
B_3V_2	290.80	294.82	294.53	40.20	42.80	44.92	125.82	122.30	126.32
B_3V_3	305.21	308.22	310.52	46.20	48.82	50.23	180.20	175.80	168.23
	F-test	**S.Ed.(±)**	**C.D.@ 0.05%**	**F-test**	**S.Ed.(±)**	**C.D.@ 0.05%**	**F-test**	**S.Ed.(±)**	**C.D.@ 0.05%**
Due to depth	S	0.03283	0.146884	S	1.362052	2.24E-15	S	0.414735	7.8E-14
Due to site	S	0.146884	0.146884	S	6.633659	6.81E-07	S	29.50423	0.90894

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