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Morphology and Physico-Chemical Properties of Upland Area of Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj

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Abstract: ***The study evaluate the morphology, physico - chemical characteristics as well as the nutrient status of upland soils, located in Sam Higginbottom University of Agriculture Technology & Sciences (SHUATS) area of prayagraj. Profile depth of 1m, with 20cm interval for 5 different samples are examined for their morphology, physical and chemical properties. A total numbers of 5 samples were collected from different depth at 20cm interval. All field and laboratory analyses were done following standard procedures. The results indicate that the nutrient status of the upland soils in the area were moderate. The nutrient status recorded a neutral pH of 7.03 in the study area, with 0.39dSm^{-1}electrical conductivity, the available nitrogen recorded was low with 139.54 kg ha^{-1}, organic carbon recorded a value of 0.9%, the organic matter also recorded a value of 1.6%.The soil has no carbonate threat with a recorded value of 0.50%.The physical properties of the soil give a bulk density of 1.30Mgm^{-3} ,particle density of 3.0 Mgm^{-3}, with total porosity of 56.80%,and a solid phase of 43.6%.The soil particle size show a textural class of sandy clay loam of 65.2% sand, 26.6% clay, 8.2% silt, with angular to sub angular blocky structure, the morphology of the study area show a yellowish brown to dark yellowish brown color, with clear and smooth horizon boundaries ,and a little abrupt distinction. The soil shows a friable consistency at the surface and a moderately hard consistency at the subsurface horizons.***
Keywords: morphology, physico-chemical properties, profile, horizons, upland.

Introduction:

The greatest interest in soil is centered on it human sustainability. People consider soil important because it supports plants that supply food, fibers, drugs, and other humans' wants, this is because it filters water and recycles wastes. Soil covers the earth's surface as a continuum, except on bare rock, in areas of perpetual frost, in deep water, or on the barren ice of glaciers. In this sense, soil has a thickness that is determined by the rooting depth of plants.

Soil morphology is the field observable attributes of the soil within the various soil horizons and the description of the kind and arrangement of the horizons. Buol, *et al* 2003, C.F. Marbut works on the reliance on soil morphology instead of the theories of pedogenesis. Which enable the classification of soil, because theories of soil genesis are both importantly dynamic, Soil Survey Staff (1993)

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The observable attributes ordinarily described in the field include the composition, form, soil structure and organization of the soil, color of the base soil and features such as mottling, distribution of roots and pores, evidence of translocate materials such as carbonates, iron, manganese, carbon and clay, and the consistence of the soil. The observations are typically performed on a soil profile, in a vertical cut of two-dimensional in the soil. The pedon give the smallest three-dimensional unit, but not less than 1 meter square on top that captures the lateral range of variability. Soil morphology can also be used to help make tillage decisions. In some coarse-textured soils where the E horizons are compact and form a tillage pan, the root system is restricted and yields may be low in the dry season because of plant water stress (Vepraskas *et al*., 1987). Crop yields can be increased in these soils by sub soiling to rip or fracture the pan, but such tillage should only extend to the top of the B horizon to avoid eventually deepening the compacted layer (Trouse, 1983). Parent material, organism, relief and time are soil forming factors that influence the morphological, physical, chemical and biological characteristics of soil. (Myansa, 2001). Understanding of soil genesis, morphology and other key of soil properties is a requirement for sustainable use of soil resources.

Russell (1973) Soil texture is one of the features that exhibit the greatest uniformity especially within short distances apart. Once form, Soil texture remains relatively static over a period of time. Most soils exhibits variation in soil texture at the topsoil layers with an increasing fineness with depth (Amalu, 1998). Structure, consistence, etc. of the soil are highly variable morphological attributes influenced by the soils mineral composition. Webster and Wilson (1980) observed that iron-rich parent materials such as basalt and dolerite will weathered to give a soil with high iron content and good structure, while granites which are low in iron but high in quartz will weathered into weak structured soil. Soil structure and texture influence its consistence. The productive capacity of any soil depends on its morphological characteristics and properties such as structure, texture, consistence etc, which influence the fertility status of soils. The study was conducted to examine the morphology, physical and chemical properties of the soil in a profile of upland (SHUATS) area of prayagraj. India.

Materials and Methods

The study was conducted to study the morphological physical and chemical attributes in soil profile of upland are of (SHUATS) prayagraj. The field experiment was carried out during the *Kharif* season 2018-2019 in the upland area of Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS) prayagraj. The upland is located in the Sam higginbottom university of agriculture, technology and sciences pragrayaj, at latitude 25^{o}24' N and longitude 81^{o}51'E, with height of 40m above sea level.

Climatic condition of the study area:

Agro climatically, prayagraj district represents the subtropical belt of the south east of Uttar Pradesh, and is endowed with extremely hot summer and fairly cold winter. The maximum temperature of the location ranges between 46^{o}C and seldom falls below 4^{o}C-5^{o}C. The relative humidity ranges between 20-94% .The average rainfalls of this area is around 1100mm annually. Prayagraj has three seasons: a hot, dry summer, a cool, dry winter and a hot, humid monsoon, the Summer lasts from March to September with daily highs reaching up to 48 °C in the dry summer (from March to May) and up to 40 °C in the hot and extremely humid monsoon season (from June to September). Begins in June, and lasts till August; high humidity levels prevail well into September. Winter runs from December to February, with temperatures rarely dropping to the freezing point. The daily average maximum temperature is about 22 °C (72 °F) and the minimum about 9 °C (48 °F).pragrayaj never receives snow, but, experiences dense winter fog due to numerous wood fires, coal fires, and open burning of rubbish—resulting in substantial traffic and travel delays. Its highest recorded temperature is 48 °C (118.4 °F), and its lowest is −2 °C (28 °F). (Allahabad climate report 2012).

Sample collections and sample analysis

Soil sample will be taken from upland soil of Sam Higgibottom University of agriculture, technology and sciences (SHUATS), at a depth of 100cm (1.0m depth) from the profile site. A total of 5 samples will be collected at depth of 0-20cm, 20-40cm, 40-60cm, 60-80cm, and 80-100cm, from the profile and will be analyzed using both field and laboratory methods.

Field Method

The field method will comprise the morphological properties such as color; structure, consistence, mottles, pores; concretions, horizon boundaries, effervescence and designation were assessed and described according to

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procedures outlined in the revised taxonomy guideline (Soil survey staff 1999).The horizon boundaries will be examine using the survey staff methods (1999)

Samples Analysis

Disturbed soil samples were air-dried, ground and passed through a 2mm sieve to obtain the fine soil fractions for determination of physical and chemical soil properties. The particles size distribution (Texture) was determined by the Bouyoucos hydrometer method (Piper, 2002). Soil pH was determined in soil-water suspension using glass electrode pH meter (Jakcson, 1958).and the soil electrical conductivity was also be determined after pH (Wilcox,1950). Organic carbon was determined by the dichromate wet oxidation method of Walkley and Black (1969).bulk density and the particle density, total porosity well as the water retention capacity were determined using the graduated measuring cylinder of black (1965).the organic matter was determine by using a vernmelen multiplication constant of 1.274, and the available nitrogen was determined by the Subbiah and Ashija (1956).And the carbonate were determined by schollenberger (1945).

Result and Discussion:

Morphological characteristics of the pedons units

Key morphological properties of the profile are shown in Table 1. The profile was well drained with friable moist consistency when wet and moderately hard when dry.

The profile depth of the study area varied from 0-100cm from the location respectively which according to Prassad and Srivastav (1993) explain that the variation in the soil depth is due topography of the area as well as the slope on which the soil is form. Hajara *et al*,. (1990) also shows that profile depth is an important influence on crop which as a result of the deep solum which provides higher soil volume for nutrient and water retention.

The upland soil is developed by Aeolian deposit. The soil color of this area is brownish yellow(10YR4/4) in horizon A, to a dark yellowish brown in horizon B. the soil is a well drain sandy clay loam soil with a moderately strong sub angular blocky structure, the consistency is a weak to moderately hard as shown in Table 2. Consistency is not only influence by physical behavior of a soil but also percentage clay minerals accumulation in the soil play a vital role Dasog, (2011) Soil color is produced by the types of minerals present and the organic matter content. The color were observed to be light yellowish brown (10YR6/4) when dry to a dark brown (10YR4/3) when moist as we move down the profile. Similar report by Nyle C and brady (2006) explain that

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brown soil color is due to the presence of high organic matter accumulation. This also in line with USDA (2014) that color development and distribution of color within a soil profile are part of weathering, Linn *et al*,. (2000), With depth below the soil surface, colors usually become lighter, yellower, or redder due to activities of mineral found in the soil. The Soil horizons were quite distinct ranging from abrupt to clear with smooth horizon boundaries. Soil pores were common and well distributed within the profile. The soils were also well developed with a weak argillic B-horizon. Major pedon units of land form were use to describe the morphological characteristic of the soil, and are presented in Table 1and Table 2.

Morphology features of the upland area

Attributes	Descriptions
Location angles(latitude longitudes)	25^{0}25'5''N, 81^{0}50'58''E
Mean annual rainfall	986mm
Mean annual temperature	26.1^{0}C (79.0^{0}F)
Locations	(Shuats)
Elevation above sea level	40m
Vegetation types	Shrubs, trees, lown grasses,cynodon dactylon
Superficial deposits	Aeoleon deposit
Land use management	Arable land (wheat cultivation)
Grid ref	Upland

Physical properties of the study area:

Soil particle size distribution

The results on the particle size from Table 3, show a sandy clay loam with 65.20% sand, 26.60% clay and 8.20% silt in the upland which goes line with the findings on the Geographical and social profile study of Allahabad Shodhganga (2011), recorded that all Allahabad belongs to 04 class of soil and are predominantly sandy loam and clay. These coarse textures control the variability of nutrient storage capacity, limit the water holding capacity and roots may grow under sub-optimal soil water due to water deficits (Gachene and kimaru 2003)**.** Similar founding were recorded by krishi vigyan Kendra (2015), that Allahabad soil were group into 4 class of which are mainly sandy loam and clay and 48% of the class are sandy clay loam soil. The sand content decreased gradually with depth as the proportion of finer particles increased, partially due to illuviation and argillation in the Bt horizons

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Brady and Nyle C (2008). Soil texture is the most stable physical characteristic of the soils which has influence on a number of other soil properties including structure, soil moisture availability, erodibility, root penetration and soil fertility Msanya *et al.*,(2003) This is because texture is a composite of the coarse fraction (sand) and the finer fractions (silt and clay) and an increase or decrease in one component imparts the opposite effect on the other and hence affects physico-chemical properties of the soils (Phiri *et al*, 2014). Clay for example has been reported to interact with organic matter and increase water and nutrient holding capacity (Landon JR. 1999).

Wakindiki and Ben-Hur (2002) expressed that in soils containing more than 20% clay, the clay particles act as a cementing agent and will increase aggregate stability against raindrops and decrease surface sealing. The silt/clay ratio, an indicator of soil susceptibility to detachment and transport, was less than the threshold of 0.4 implying moderate resistances to erosion (Wanjogu 1992).

Particle density and bulk density:

Table 3 is the result from the upland which showed a minimum value of 2.85Mgm^{-3} across the horizon and a higher value of 4.0Mgm^{-3} B_3 horizon, with a mean value of 3.0Mgm^{-3}. And this particle density of soil varies with the nature or type of textural class (Rhulman *et al.*, 2006). It is also evident that the particle density of different mineral particle-size fractions can be distinguished statistically. When working with soil inventory data sets originating from large geographic areas, the predictive capability of any regression equation developed is likely to be influenced by the soil taxonomic range (Heuscher *et aI.*, 2005). While the bulk density shows a minimum of 1.25Mgm^{-3} to a maximum of 1.43Mgm^{-3} with a mean average value of 1.30Mgm^{-3} as shown in Table 3, this was also report similarly by yoyo and Umi (2012).

Agus *et al*.(2006) suggested that soil bulk density had a close relationship with root penetration into the soil, soil drainage and soil aeration, and other soil characteristics that soil bulk density was inversely related to total soil porosity, which provided a measure of the porous space left in the soil for air and water movement. Lower bulk density implied greater pores space and improved aeration, thus, developed a suitable environment for biological activity and plant growth, (Islam and Weil 2000). For any given soil, the higher the bulk densities, the more compacted the soil is and the lower the pore space vice visas as also observed in this profile. This variation in bulk density also affects the soil water transmission properties (Karuku *et al* 2012).

Water retention capacity, porosity and solid phase:

The result from Table 2 showed the upland pedon data on the water holding capacity of the horizon, where it recorded a lower value of 51% in both horizon A and horizon $B_{1,}$ with a higher value of 55.69% in horizon B_3,

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with mean value of 52.6% in the whole horizon. The results from the study location show a remarkable value in the water retention at both surface and underlying horizon of the soil units and this could be attributed to the percentage clay content difference as reported by Jones and Wild (1975), that the greater the clay content of the soil the greater the difference in their moisture retention. Differences in water retention in landforms may be due to different morphological characteristics (Olayele *et al* 2016). The porosity shows a lower value of 32%in the lower horizon and a higher value of 50% in the upper horizon, with a mean average value of 43.6% solid phase. This variation is as a result of the kind of parent materials, weathering, minerals deposition etc. that take place in the soil environment (Russell 1973). The result on the solid phase from the upland pedon unit from Table 2b which shows a lower value of 32%in the lower horizon and a higher value of 50% in the upper horizon, with a mean average value of 43.6% solid phase. This variation is as a result of the kind of parent materials, weathering, minerals deposition etc. that take place in the soil environment (Russell 973).

Chemical properties of the study area:

Soil reactions (pH) and EC.

The pH result on the upland pedon were presented in Table 4 and it show a pH value of 6.5 and 6.9 in horizon Ap and A, and a values of 7.1, 7.2.and 7.3 in horizon B_1,B_2,and B_3 respectively, with a mean value of 7.03 pH in the upland horizon. the result for the electrical conductivity(EC) obtained from the upland soil show a conductivity value of 0.45 in the top soil of Ap horizon and value range of 0.38, 0.37, 0.37 and 0.39 in horizon A,B_1, B_2 and B_3 respectively with a mean value of 0.39 dSm^{-1} in the whole horizon. The results also show that the higher value of the electrical conductivity in the upland soil is found in the sup- surface horizon as compared to lower horizon in the lowland having the higher value of electrical conductivity. Electrical conductivity measurements are good estimate of topsoil thickness, which may be used to diagnose potential rooting and water-related problems affecting grain crop production. Pillai and natarajan (2014) reported a similar work that electrical conductivity with low value indicates non saline. Jaiswal (2006) also reports that a soil with 0.3 to 0.5 electrical conductivity is considers a moderately saline soil therefore pose no threat to crop production. Electrical conductivity of $4dSm^{-1}$ in a saturated extracts are considered a critical value above which the soil are saline (sehgal 1996).

Percentage Organic carbon and organic matter, and available nitrogen:

Table 4 showed the result obtained from the upland area with organic carbon percentage ranging from 1.09% in horizon Ap, 0.78% in A horizon, 1.02% in B_1 horizon, 0.60%in B_2 horizon and a higher value of 1.20% in the lower B_3 horizon, and a mean average value of 0.94% was recorded in the upland. The percentage organic matter of the soil in upland also showed a lower value of 1.89% in horizon Ap to a higher value of 2.07% in horizon B_3 and a mean value of 1.62% was recorded. Organic carbon value of 0.20%, 0.40%, 0.80% and above are considered very low, low, medium and higher, Jaiswal (2006). Organic Carbon increases or decreases in parallel with increasing or decreasing finer soil particles, respectively. Therefore, the fraction of finer soil particles of a given soil type represents an important predictor of organic carbon content (Parton *et al*. 1987). This also showed that soil organic carbon content is influenced by various regional factors, such as soil type, texture, topography, land use type, and management practices (Hao and Kravchenko 2007). Similar report was recorded by Sehgal (1996). The result on the the available nitrogen status from the upland as shown in Table 4, ranges from 94.3kg ha^{-1} to 157kg ha^{-1}, with a lower value of 94.4kg ha^{-1} in Ap horizon, to a higher value of 157kg ha^{-1} in the surface B_3 horizon. The mean value of nitrogen from the upland area was 139kg ha^{-1}. Upland nitrogen showed lower value, this may be due to variation in their organic carbon and organic matter content in the soil (Ashok 2001). This also agreed with Brady (2008) that correlation between organic carbon and nitrogen determine the availability of nitrogen in the soil. The maintenance of nitrogen level in the soil is a function of the maintenance of carbon and organic matter in the soil is dependent to no small degree on the level of nitrogen in the soil (Das 1996

Percentage carbonate

Carbonate affects both the physical condition and nutrient availability in soil. A high concentration of carbonate for example lime form a hard layer pan (calcic and petrocalcic horizons), (Sehgal 1996)**.**The result on the carbonate content from the study areas as showed from Table 4, give a lower value of 0.3% and 0.4% carbonate in horizon B_1 and B_2, with medium value of 0.5% to 0.53% in Ap and A horizons, and a higher value was recorded in B_3 horizons. The mean value of the carbonate in upland area was 0.5%, which also indicates a very suitable class in the suitability class of soil. From the soil pH result as showed earlier in table 3, for the study site, it showed that the soil of this area are slightly alkaline therefore has no carbonate threat to cultivation. This value range has no limitation to crop production which according to Sehgal (1996**)** fall in the very suitable class of soil suitability classification.

Conclusion

The study of upland area of SHUATS prayagraj, show the pH to be neutral, the soil of the locations show no salinity problem and the organic carbon and organic matter content of the location were moderate, however ,the

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available nitrogen status show a moderate values of 1.39kg/g . The physical properties of the soil give a bulk density as well as a particle density that were good for the soil rating, the soil also indicated a good water retention capacity in the upland. And the percentage pore spaces and the carbonate status of the soil area show a normal condition for the area.

Table1: morphological characteristics of upland area

Horizon	Depth Cm	Texture	Colour matrix Dry	Colour matrix wet	Structure	Consistency Moist	Consistency dry	Horizon boundary	Carbonate reaction
Ap	20	SCL	by10YR6/6	dyb10YR4/4	Sbk	fi	md	Cs	St
A	40	SCL	by10YR6/6	yb10YR5/4	Sbk	fi	md	Gw	St
B_1	60	SCL	by10YR6/6	dyb10YR4/4	Abk	fi	hd	Gw	St
B_2	80	SCL	by10YR6/6	dyb10YR4/4	Abk	fi	hd	Cs	Ne
B_3	100	SCL	by10YR5/6	yb10YR5/4	Abk	fi	hd	Cs	Sl

Key:

SCL=sandy clay loam, by=brownish yellow, yb= yellowish brown, dyb=dark yellowish brown, Sbk= sub angular blocky, abk= angular block, fi= firm, md=moderately hard, hd= hard, wg= gradual wavy, cs= clearly smooth, st=strong effervescence, ne= no effervescence.

AP	0-20	Dark brown(10yr4/3),sandy clay loam, granular structure to weak subangular blocky, moderately hard consistency, pH 6.5, little abrupt with clear and smooth boundary
A	20-40	Dark brown (10YR4/3) sandy clay loam, subangualr blocky structure, moderately hard consistency, pH 6.9 clear and smooth boundary
B_1	40-60	Dark brown (10YR4/3) sandy clay loam, subangular blocky structure, moderately hard consistency, pH 7.1, clear and smooth boundary.
B_2	60-80	Dark brown(10YR4/3) sandy clay loam, platy structure, hard consistency,pH7.6, clearly smooth boundary
B_3	80-100	Dark brown(10YR4/3) sandy clay loam, platy structure hard consistency, pH 7.3, clearly smooth boundary

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Table 3: physical properties of the upland area

Horizon	Depth cm	Texture% sand	silt	clay	Texture class	PD Mgm^{-3}	BD Mgm^{-3}	Pores pace (%)	Solid phase (%)	WHC (%)
Ap	0-20	68	10	22	SCL	2.85	1.25	56.00	44.00	54.55
A	20-40	63	8	29	SCL	2.85	1.43	50.00	50.00	51.52
B_1	40-60	70	3	27	SCL	2.85	1.25	56.00	44.00	51.52
B_2	60-80	65	7	28	SCL	2.85	1.33	53,30	47.30	50.00
B_3	80-100	60	13	27	SCL	4.00	1.25	68.0	32.80	55.88
Mean	**5.0**	**65.20**	**8.20**	**26.60**		**3.00**	**1.30**	**56.80**	**43.60**	**52.69**

Table 4: chemical properties of the upland area

Horizon	Depth Cm	pH 1:2	OC (%)	OM (%)	N $(kgha^{1)})$	EC_{25} $(dSm^{-1)})$	Carbonate (%)
Ap	0-20	6.51	1.09	1.89	188.6	0.45	0.5
A	20-40	6.92	0.78	1.34	94.3	0.38	0.53
B_1	40-60	7.14	1.02	1.76	116.3	0.37	0.40
B_2	60-80	7.25	0.60	1.03	141.5	0.37	0.30
B_3	80-100	7.33	1.20	2.07	157.0	0.39	0.78
Mean	**5.00**	**7.03**	**0.94**	**1.62**	**139.54**	**0.39**	**0.50**

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