Effect of physico-chemical properties of soil under various depths on different cropping systems in Ayodhya

Abstract

A research work conducted during 2018-19 at Agronomy farm of Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) to evaluate the fertility status and effect of different cropping systems on soil physico-chemical characteristics and their correlation. The 300 representative soil samples with 4 depths viz. 0-15, 15-30, 30-60 and 60-90 cm soil samples were taken with manually driven post hole auger and processed for soil analysis from different plots of Agronomy farm. Results revealed that physico-chemical properties *viz*. particle Density, bulk density pH, EC, organic corban, nitrogen phosphorus potassium Sulphur and zinc varied vertically and horizontally in cultivated and fallow lands. The soils were sandy loam, clay loam, loam and silt loam. The frequency distribution of soil bulk density of entire farm ranged from 1.128-1.58 Mgm^{-3}, particle density ranged 2.50-2.76 Mgm^{-3} and soil chemical properties, like, pH ranged from 7.2-11.5, the E.C. is found in ranged from .13-1.01 dSm^{-1}. While organic carbon was ranged from 1.4-6.70 g $kg^{-1.}$ and notable available Nitrogen in Agronomy farm was low in ranged from 170.15-221.36 $kgha^{-1}$.The Phosphorus availability was found in ranged from 6.01-16.87 $kgha^{-1}$, while Potassium was found in ranged from 163.20-220.98 $kgha^{-1}$. How ever the availability of Sulphur, was found in ranged from 8.62-18.32 $kgha^{-1}$, Zinc ranged from in Agronomy farm 0.28-0.81$mgkg^{-1}$. The significant positive correlation were observed among soil B.D with N, B.D with P, B.D with K, B.D withS, P.D. with S, P.D. with Zn. While the significant negative correlations were observed among PD with O.C., Zn with P, Zn with K and Zn with S in whole Agronomy Farm.

Keyword: Pearsons Correlation coefficient, physico- chemical properties, macro-nutrient standard deviation.

INTRODUCTION

Soil is a vital natural resource on earth crust which supports life system socio-economic development of a country. The successful agriculture requires the sustainable use of soil resources, because soil easily lose their quality and quantity within short period of time. Due to increasing population and acquisition of fertile land of urbanization the cultivable land for agriculture land decrease day by day. The per capita cultivable land has been declined from 0.32 ha in 1950s to, 0.14 ha by end of century and assume to be less than 0.1 ha in 2020 (Goldewijk, 2017). There for challenges are being faced not only increasing productivity on sustainability basis, but also preserving and maintaining soil resources for future. The soil productivity and sustainability depend on a dynamic equilibrium among its physical, chemical and biological properties. Cropping system is an important component of farming system. It represents cropping patterns used on farm and their interaction with farm resources, other farm enterprises. It includes all spatial and temporal aspect of managing an agriculture system. Adoption for formulating the plans to suggest cropping system which help to minimizing the deterioration of land quality controlled by soil physical conditions, nutrient availability, and organic carbon pool.

Assessed soil reaction status under different land use types. Based on results of the study, variation on soil physico-chemical properties were observed under soil of selected land type in the study area variation on soil physico-chemical properties could be related to frequent agronomic practice (Muche and Kakeb, 2015). The degradation of high land soil with restricted depth by cultivated seriously impaired soil properties and results in significant decrease in SOM, aggregate stability and its crucial effect on soil physical properties bulk density particle density etc. (Celik, 2004). The plant micronutrient data are needed in the analysis of environment processes and problem that must be understood if living conditions and understands are to be improved and maintain at current levels. The different farms of the university are under different land use. The farms are the in-development stages and the basic information regarding the land use patterns, soil

fertility status is needed for the future and development programs. The yield potential of different farms is deteriorating in different years. For the upcoming research and development programs, fundamental knowledge on the land use pattern and soil fertility status is required because the farms are still in the development stage. Keeping these facts in mind, the research paper is depth-wise distribution of soil's physical and chemical attributes under various cropping methods in Ayodhya's salt-affected soils.

MATERIALS AND METHODS

The investigation was carried out at Agronomy Farm of Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.), during the year 2018-19. The Farm is located at a distance of 42 kms from away from Ayodhya city on Faizabad - Raibareli road and situated at 26°32´ N latitude, 81°50´E longitude and at an altitude of 113.0 meters from the mean sea level. The cropping systems under Paddy-chickpea-fallow, Paddy-wheat- fallow, fallow -chickpea- fallow, fallow -maize- fallow, Paddy-mustard-fallow, Paddy-wheat-maize, Paddy-potato- fallow, Guava fruit tree+ lemon, Paddy-wheat-maize, Farm + dairy, Paddy-chickpea- fallow, Brinjal- chickpea – fallow, Bajra- wheat – fallow, Pigeon pea-mustard- fallow, fallow, .The total twenty-five plots and number of samples is 300 were selected by using the GPS location of plots with the help of post whole Auger from four depths; surface (0-15 cm) and sub-surface; (15-30 cm) (30-60 cm) and (60-90cm) during the month of April to May 2019. The total area of Fourteen (14.0) hectares and distributed in normal Cultivated area 11.5 hectares, Farm area and guava orchard area 1 hectares, Area under dray land 1.5 hectares. The evaluation of physico-chemical properties of soil. The normal protocols were followed for analyzing the soil samples. There was sandy, loamy, and silty soil there. The correlation coefficient, r, is known as the pearson's correlation coefficient because Karl Pearson developed it. Correlation between various soil properties was measured, and regression equations were worked up in accordance with the procedures provided by Chandel (1984). The standard deviation is defined as the square root of the mean of the squared deviation of individual value from their mean.

Result and discussion:

1.0. Soil physical properties of Agronomy farm (University Campus)

It is evident from the data that show maximum bulk density was recorded in Paddy-chickpea- fallow (P20) under the depth of 60-90 cm is 1.58Mgm^{-3} and the minimum bulk density was record from Bajra- wheat - fallow (P22) at depth of 0-15 cm the lowest value of bulk density 1.28 Mgm^{-3} was recorded. The maximum particle density 2.76 Mgm^{-3} was found in Pigeon pea-mustard- fallow (P24) under depth of 60-90 cm and the minimum particle density 2.50 $Mgm^{-3}$was found in Paddy-chickpea-fallow (P1) in the depth of 0-15 cm. The range of bulk density of 25 plot and 300 sample from 1.28 -1.58 Mgm^{-3}, particle density 2.50 – 2.76 Mgm^{-3}. The average bulk density of farm is 1.43 Mgm^{-3}, particle density is 2.69 Mgm^{-3} of the entire Agronomy farm. The Standard deviation of bulk density is 0.29, particle density is 0.081 on the Agronomy farm under 25 plots. These finding also corroborated with the findings **of Mengiste *et al.*, (2015), Patton *et al.*, (2007), Dutta, *et al.*, (2015), Saqeebulla *et al.*, (2012), Rahman *et al.*, (2012).**

1.2. Soil pH, Organic carbon and Electrical conductivity of Agronomy farm (university campus) -

The data evident from the table that maximum pH (11.5) was recorded from Paddy -wheat - fallow (P11) with depth 60-90cm and minimum pH (7.2) was recorded at Paddy-wheat- fallow 3(P3) with the depth of 0-15 cm. The electrical conductivity is concern, the maximum E.C. (1.01 dSm^{-1}) was recorded in Paddy-wheat- fallow (P6) at 15-30 cm, and minimum E.C. (0.13 dSm^{-1}) was recorded in Paddy-chickpea- fallow (P18) with the depth of 15.30 cm. As the maximum Organic carbon (6.70 g kg^{-1}) was recorded from Paddy - wheat - fallow (P11) with the depth of 0-15 cm whereas, minimum O.C (1.14 g kg^{-1}) was recorded at Paddy-mustard- fallow (P5) with depth of 60-90 cm. The pH value ranged of the 25 plot of the farm from 7.20-11.50 and with an average value of 8.7, electrical conductivity (E.C.) ranged from 0.13 - 1.01 dSm^{-1} and with an average value 0.18 dSm^{-1}, organic carbon ranged from 1.14 - 6.70 gkg^{-1}. The average value organic carbon is 3.4 g kg^{-1}. The standard deviation of pH, organic carbon and electronic conductivity were 1.57, 0.160 and

0.75 respectively. The pH value ranged of the 25 plot 300 sample of the farm from 7.20-11.50 and with an average value of 8.7, electrical conductivity (E.C.) ranged from 0.13 - 1.01 dSm^{-1} and with an average value 0.18 dSm^{-1}, organic carbon ranged from .14- 0.67 g kg^{-1}. The average value organic carbon is 0.34 g kg^{-1}. It is also clear from the data the organic carbon decreased with increasing the depth of soil. The Similar results were also found by **Saha *et al.*, (2000), Singh *et al.*, (2012), Singh *et al.*, (2016), Saeed *et al.*, (2007), Sharma *et al.*,(2010), Ndukwu *et al.*, (2010).**

1.3 Available Nitrogen, Phosphorous and Potassium of Agronomy farm (university campus) -

The data from the table evident that the maximum available nitrogen (221.36 kg ha^{-1}) was recorded from Plot no. 12 (P12) with the depth of 0-15 cm where cropping system is Paddy-Chickpea-Fallow and minimum Nitrogen (170.15 kg ha^{-1}) was recorded at Plot no. 9 (P9) with the depth of 60-90 cm where cropping system is Paddy-Wheat-Fallow. The maximum available phosphorus (16.87 kg ha^{-1}) was recorded with the Plot no.13 (P13) with the depth of 0-15 cm where cropping system is Paddy- potato-Fallow whereas minimum available phosphorus (6.01 kg ha^{-1}) was found at Plot no. 23 (P23) with the depth of 60-90 cm where cropping system is Pigeon pea-Mustard-Fallow. As the Potassium is concern the maximum available potassium (220.98 kg ha^{1}) was recorded in Plot no. 5 (P5) at depth of 0-15 cm Paddy-Mustard-Fallow and minimum available potassium (163.20 kg ha^{-1}) was found in the Plot no. 14 (P14) with the depth of 60-90 cm where cropping system is guava fruit tree + lemon. The standard deviation of N, P, and K were 18.64, 3.29 and, 37.00 (kg ha^{-1}) respectively. The value ranged of the 25 plot 300 sample of the farm available nitrogen was ranged from 170.15-221.36 kg ha^{-1} with an average value of 197.57 kg ha^{-1}, available phosphorus ranged from 6.01-16.87 kg ha^{-1} with an average value 11.57 kg ha^{-1}, and available potassium ranged from 163.20 -220.98 kg ha^{-1} with an average value 193.96 kg ha^{-1}.The increase in nitrogen and phosphorus availability might be due to the high organic matter in surface soil which favored the decomposition and accumulation of organic matter, solubilization of insoluble phosphorus and also supplementing the depleted phosphorous through external sources which releasing more quantity of nutrients. The results were also corroborated with the finding of **Shiva Kumar *et al.*, (2017)**, **Gobinder Singh *et al.*, (2016), Mishra *et al.*, (2012), Sharma *et al.*, (2010)**.

1.4 Soil available Sulphur and Zinc status of Agronomy farm (university farm) -

The evident from the data that the maximum available Sulphur (18.32 $kgha^{-1}$) was recorded in Plot no. 7 (P7) with the depth of 0-15 cm where cropping system is Paddy-Mustard-Fallow where as minimum available Sulphur (8.62 $kgha^{-1}$) was found in plot no. 18 (P18) at depth (60-90 cm) where cropping system is Paddy-Chickpea-Fallow. The maximum available zinc (0.81$mgkg^{-1}$) was recorded in Plot no. 20 (P20) with the depth of 0-15 cm where cropping system is Paddy-Chickpea-Fallow and minimum available zinc (0.28 $mgkg^{-1}$) was found at Plot no. 13 (P13) with depth 60-90 cm Paddy-Potato-Fallow. The standard deviation of S and Zn were 1.3 (kg ha^{-1}) and .170 3 (mg ha^{-1}) respectively. The available sulphur was ranged from (8.62 - 18.32kg ha^{-1}) and with an average value of (12.83kg ha^{-1}), and available zinc ranged from (0.28-0.81mg kg^{-1}) and with an average value (0.55 mg kg^{-1}). The majority of soil sample collected from the soil which has followed the cropping system as Paddy-Mustard. This might be due the addition of organic matter and solubilization of the nutrients in surface soil. This agreement with the finding reported by **Sharma *et al.*, (2010)**, **Singh *et al.*, (2011)**, **Saeed *et al.*, (2007), Sharma *et al.*, (2010), Ndukwu *et al.*, (2010).**

Significant at 1% Level of Significance-

The Correlation between physico - chemical properties is represented in table No 1. The results reveals that the B.DV/s N, B.DV/s P, B.D V/s K B.D V/s S and P.D. V/s Sand, Zn showed significantly and positively correlation at 1% level of significance, whereas the significantly and negative correlations were found among P.D V/s O.C., P V/s Zn, K V/s Zn and S V/s Zn at 1% level of significance.

Conclusion:

There is need to apply balances doses of nutrients on soil test basis, application of organic manures and proper use of agrochemicals preferably bio-pesticide and bio herbicide and adopt INM, IPM practices in

farming to improve the fertility, productivity, and soil quality. On the basis of present investigation, it may be concluded that for the maintenance of soil health, availability of nutrients sustainability of soil may be possible with the adoption of leguminous crops with other crops for their profitability and productivity.

Table-1: Mean Correlation among physico - chemical properties of soil verses macro and micro nutrient i.e. N, P, K, S and Zn (university campus)-

Cropping system.	Bulk Density (Mgm^{-3})	Particle dens (Mgm^{-3})	pH	E.C.	O.C. (%)	Available nutrient (kg ha^{-1})			Sulphur (kg ha^{-1})	Zinc (mg kg^{-1})
						N	P	K		
P1	1.32-1.56	2.50-2.76	7.5-9.8	0.31-0.88	2.0-5.60	189.52-220.18	7.43-11.32	178.33-198.5	15.13-8.62	.39-.67
P2	1.36-1.52	2.52-2.68	7.2-9.9	0.34-0.94	2.5-4.60	186.68-217.00	7.65-14.75	178.87-215.87	10.89-16.20	.37-.63
P3	1.31-1.80	2.60-2.68	7.2-9.1	0.34-0.38	2.7-5.60	189.15-215.72	6.6-14.56	186.75-218.34	8.88-14.77	.34-.60
P4	1.32-1.47	2.66-2.72	7.3-7.6	0.34-0.96	2.8-4.80	182.76-218.56	8.90-15.87	175.06-199.76	8.77-16.20	.43-.72
P5	1.34-1.48	2.51-2.58	7.6-10.25	0.34-0.81	1.4-5.80	184.88-220.16	8.65-14.98	186.78-220.98	9.15-14.86	.35-.68
P6	1.31.1.48	2.56-2.68	7.9-10.2	0.27-1.01	2.41-5.82	188.70-215.15	7.65-12.46	189.09-212.87	9.33-16.36	.29-.66
P7	1.35-1.52	2.62-2.70	7.9-9.1	0.37-0.87	2.92-5.46	186.6-216.16	8.39-13.84	174.98-192.12	10.61-18.32	.29-.43
P8	1.33-1.48	2.63-2.72	7.3-9.5	0.37-.96	2.10-4.40	182.19-214.15	8.65-15.87	179.02-210.98	9.44-17.32	.31-.48
P9	1.3-1.51	2.61-2.71	7.8-9.5	0.41-0.61	3.11-3.90	170.15-212.15	8.62-16.78	176.76-211.98	9.12-14.10	.42-.60
P10	1.33-1.78	2.61-2.72	8.7-10.39	0.25-0.83	2.00-4.60	180.89-208.64	8.76-16.54	186.43-215.43	8.56-16.52	.39-.69
P11	1.34-1.50	2.56-2.65	7.9-11.5	0.37-0.89	2.70-6.70	185.12-218.15	8.06-13.98	182.94-208.54	12.47-16.32	.43-.63
P12	1.34-1.90	2.68-2.91	7.8-10.40	0.31-1.0	1.98-4.71	178.44-221.36	8.87-14.76	174.35-197.23	10.15-18.08	.38-.68
P13	1.41-1.82	2.63-2.82	8.8310.43	0.27-0.39	2.32-4.60	120.08-161.16	9.04-12.87	193.23-202.10	10.52-18.13	.28-.49
P14	1.39-1.90	2.69-2.81	7.9-9.5	0.41-0.91	1.78-4.69	172.33-198.72	8.37-14.65	163.20-199.12	9.33-14.51	.36-.63
P15	1.47-1.96	2.68-2.89	7.9-8.6	0.54-0.84	2.46-4.65	184.17-218.76	8.92-14.80	187.11-219.12	9.35-17.65	.38-.69
P16	1.43-1.92	2.69-2.93	8.1-10.48	0.58-0.88	2.81-4.91	168.-191.13	8.83-13.83	177.30-210.21	8.55-14.75	.46-.77
P17	1.39-1.82	2.61-2.91	7.9-10.3	0.44-0.64	1.40-4.10	176.19-194.79	8.89-12.90	181.23-198.10	9.95-16.28	.34-.69
P18	1.45-1.80	2.69-2.86	7.8-8.9	0.31-0.81	2.40-5.20	176.12-218.35	7.56-15.98	180.45-219.21	8.35-14.69	.38-.71
P19	1.60-2.03	2.61-2.84	7.6-10.7	0.59-0.81	2.07-6.30	189.12-216.11	7.36-13.87	179.40-205.24	9.91-15.13	.58-.70
P20	1.39-1.82	2.35-2.95	7.4-10.15	0.13-0.14	2.11-4.30	113.76-240.15	9.80-17.16	173.23-192.30	9.42-16.22	.54-.81
P21	1.66-1.94	2.52-2.85	7.8-8.9	0.44-0.84	2.80-7.19	178.15-212.10	8.54-16.87	180.34-198.10	8.93-15.51	.39-.76
P22	1.28-1.90	2.52-2.91	8.1-10.3	0.42-0.88	1.89-5.10	173.15-203.75	9.81-13.91	172.12-195.32	9.44-17.52	.39-.69
P23	1.60-1.96	2.62-2.82	7.9-9.1	0.64-0.94	1.75-5.11	180.12-215.19	6.01-12.57	192.34-217.54	10.44-18.55	.24-.61
P24	1.45-1.90	2.58-2.85	7.8-9.5	0.39-0.63	2.06-5.90	180.92-215.15	9.63-15.78	170.94-198.34	12.42-18.05	.46-.78
P25	1.59-1.90	2.66-2.92	7.3-9.3	0.34-0.96	2.90-3.85	189.27-209.32	8.79-12.23	176.07-199.19	8.62-18.32	.28-.81
Average	1.43	2.64	8.70	0.61	3.47	197.57	11.57	193.77	12.83	0.55
S.D	0.29	0.081	1.57	0.160	0.75	18.64	3.29	37.00	1.33	.17

Table-2: Correlation among physico-chemical properties of soil verses macro and micro nutrient i.e. N, P, K, S and Zn (university campus)-

Parameter	**Bulk density (Mgm^{-3})**	**Particle density ($Mg\ m^{-3}$)**	**pH**	**E.C ($dSm^{-}1$)**	**Organic carbon ($g\ kg^{-1}$)**	**N**	**P**	**K**	**S**	**Zn**
Bulk density (Mgm^{-3})	1.00									
Particle density ($Mg\ m^{-3}$)	.344	1.00								
pH	.352	.432	1.00							
E.C. (dSm^{-1})	.901	.18	.0124	1.00						
Organic carbon ($g\ kg^{-1}$)	.168	-.752**	.0041	.379	1.00					
N	.892**	.43	.026	.187	0.264	1.00				
P	.897**	.79	.015	.106	-.099	.106	1.00			
K	.678**	.416	.026	-.004	.030	.081	.0307	1.00		
S	.868**	.792**	.145	.259	.017	.092	.1577	.0344	1.00	
Zn	.289	.597*	.045	.034	.051	.045	-.750**	-.712**	-.825**	1.00

Reference:

Bouyoucous, H.J; (1962). A hydrometer method for the determination of textural classes of soils. *Tech. Bul.* 132. Michigan State coll. Agr. Exp. Stn. 1-38.

Celik, I.; (2004). Land-use effects on organic matter and physical properties of soil in a southern Mediterranean highland of Turkey. *Soil Tillage Research,* **83:** 270-277.

Dutta, M.; Diengdoh, J. and Sewak Ram (2015). Physico-chemical properties of west Khasi Hills soils of Meghalaya in relation to land uses. *Asian Journal of Soil Science,* **10(2):**288-294.

Mengiste, W.; Muktar, Mohammed and Yitebarek, T. (2015). Evaluation of the effect of land use types on selected soil physic-chemical properties in Itangkir area of Gambella region, Ethiopia. *Journal of Biology Agriculture and Health Care,* **5(11) :** 92-102.

Ndukwu, B. N.; Idigbor, C. M.; Onwudike, S. U. and Chukwuma, M. C. (2010). Evaluation of the Effects of Selected Agricultural Land Utilization Types on Soil Properties in Nando South eastern Nigeria. *International Journal of Sustainable Agriculture*, **2:** 34- 38.

Ndukwu, B. N.; Idigbor, C. M.; Onwudike, S. U. and Chukwuma, M. C. (2010). Evaluation of the Effects of Selected Agricultural Land Utilization Types on Soil Properties in Nando South eastern Nigeria. *International Journal of Sustainable Agriculture*, **2:** 34- 38.

Patton, S.; Sharma, S. K. and Singh, P. K. (2007). Characterization of the acidity of soils under different land use patterns in Nagaland. *Journal of the Indian Society of Soil Science,* **55(2):** 134-138.

Rahman, M. H.; Bahauddin, M. Khan, M. A. S. A.; Islam, M. J. and Uddin, M.B;(2012). Assessment of soil physical properties under plantation and deforested sites in a biodiversity conservation area of north eastern Bangladesh. *International Journal of environmental sciences,* **3(3):** 1079-1088.

Rudramurthy, H.V.; Puttaiah, E.T. and Vageesh, T.S.(2007). Chemical properties of soils under different land use systems in Shimoga District of Karnataka. *Journal of the Indian Society of Soil Science*, **55(3):** 259-264.

Saha, A. K.; Saha, N. and Pal, S. K. (2000). Distribution of organic carbon and nitrogen in some Tarai soils of West Bengal. *Agropedology,* **10***:*132-138.

Saqeebulla, H. M.; Gurumurthy, K. T. and Prakasha, H. C. (2012). Physicochemica lproperties of soils under different land use system. *Mysore Journal of Agriculture Science,* **46(1):** 99-105

Sharma, P. K.; Bordoloi, P. K.; Baruah, T. C.; Das, K. N. and Borah, N. (2010). Physical characterization of soils in two command areas of Assam. *Journal of the Indian Society of Soil Science* ,**45:** 709-712.

Sharma, S.; Chander, G. and Verma, T. S. (2010). Soil microbiological and chemical changes in rice-wheat cropping system at Palampur (Himachal Pradesh) after twelve years of *Lantana camara* L. residue incorporation. *Journal of Tropical Agriculture,* **48 (1-2):** 64-67.

Singh, B and Sharma K.N. (2012). Depth wise distribution of soil organic carbon and nutrients under tree species after seventeen year of plantation. pp.198-203

Singh, G., Sharma, M., Manan, J. and Singh Gurmeet;(2016) Assessment of soil fertility status under different cropping sequences in district kapurthala. *Journal of Krishi Vigyan*. **5(1):**1-9.