



Effect of land use systems on soil health in eastern region of Uttar Pradesh

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Diversity of microorganisms in soil mainly depends on rainfall, temperature, amount and type of nutrients available, available soil moisture, degree of aeration and soil reaction (Babu *et al.* 2020). Soil bacteria and fungi play roles in various biochemical cycles and are responsible for the recycling of organic compounds. Soil microorganisms also influence above ground ecosystems by contributing to plant nutrition, plant health, soil structure and soil fertility (Singh *et al.* 2020). Agricultural practices such as fertilization and tillage influence soil chemical properties and nutrient dynamics throughout the soil profile (Das *et al.* 2020). The soil microbial biomass is fundamental to maintaining soil functions because it represents the main source of soil enzymes that regulate transformation processes of elements in soils, and it has been suggested as possible indicator of soil environment quality (Sahoo *et al.* 2019). Different experimental farms of the university have different land use system. The farm is in developing stage and the basic information regarding the land use patterns is needed for the future research and development programmes. Therefore, an attempt was made to investigate the effect of different land use on soil properties of different experimental farm of the university.

The study was carried out during 2017-2018 at Research Experiment Farm of ANDUAT, Kumarganj, Ayodhya, Uttar Pradesh. The farms is worst affected by salt infestation and has an area of 126 ha. Farms have different land use system like crop land, plantation and forest. The soils are confined to the alluvial belt whose geology is dominated by alluvium deposits from the Gomati and Ghaghara rivers.

The total three land use systems were selected and total 36 samples were taken with GPS location, 12 from crop land, 12 from plantation land and 12 from forest land, respectively at 0-15 cm depth with the help of soil auger and *khurpi*. The samples collected from different spots in polythene bags, it was dried in shade condition after that it was mixed and crushed gently with the help of mortar and pestle, and then it was sieved with 2 mm sieves. The soil samples were analyzed for different soil properties by following the standard procedures, viz. bulk density (Mg/m³) (Black 1955); pH (Jackson 1967); available nitrogen (kg/ha) (Subbiah and Asija 1956); available phosphorus (kg/ha) (Olsen *et al.* 1954); available potassium (kg/ha) (Jackson 1967); soil organic carbon (%) (Walkley and Black 1934) (Table 1). Isolation and identification of viable bacteria, actinomycetes and fungi count was employed serial dilution and plating techniques suggested by Rao (1999). The data collected of different parameters of soil and a linear model of SAS 9.4 (SAS Institute 2003) was used for statistical analysis of data in this study. The least significant difference (P=0.05) was used to compare means among land use systems.

The results revealed that lowest soil pH 8.32 was recorded under LBSCS and highest soil pH 8.57 was found under RWCS. Lowest soil pH was noticed under mango orchard and highest soil pH was registered under aonla orchard. Sisal forest recorded lowest soil pH 8.26 but eucalyptus forest registered highest soil pH 8.67. The cropping systems and plantation crops influenced the soil pH because decomposition of organic matters in soil which release several organic acids that result neutralize the soil pH (Babu *et al.* 2020). The LBSCS was observed lowest BD 1.28 g/cc RWCS registered highest value of BD 1.37 g/cc. Mango orchard recorded lowest BD 1.28, whereas highest BD 1.32 g/cc was recorded under aonla orchard. The lowest BD was observed under sisal forest while highest BD 1.34 g/cc was recorded under eucalyptus forest. Because in different crop land use systems ploughing of land should be done by heavy machinery that results compaction of soil which ultimately increased bulk density but in other land

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Table 1 Effect of different land uses systems on physico-chemical properties of soil

Different land use systems	Soil pH		Bulk density (g/cc)			Soil organic carbon (%)			Available nutrient (kg/ha)									
	Kharif	Rabi	Mean	Kharif	Rabi	Mean	Kharif	Rabi	Mean	N			P			K		
										Rabi	Mean	Kharif	Rabi	Mean	Kharif	Rabi	Mean	Kharif
Crop land use system																		
RWCS	8.52	8.61	8.57	1.36	1.38	1.37	0.34	0.36	0.35	174	176	175	16.8	16.0	16.4	240	238	239
LBSCS	8.31	8.33	8.32	1.28	1.27	1.28	0.40	0.39	0.40	200	201	201	18.0	16.5	17.3	245	244	245
VBCS	8.42	8.50	8.46	1.32	1.35	1.34	0.34	0.37	0.36	198	199	199	17.0	16.5	16.8	237	234	236
Mean	8.40	8.47	8.44	1.30	1.30	1.33	0.36	0.37	0.37	191	192	192	17.3	16.3	16.8	241	239	240
Plantation land use system																		
Mango orchard	8.20	8.41	8.31	1.29	1.27	1.28	0.41	0.43	0.42	204	205	205	18.0	17.5	17.8	238	237	238
Bael orchard	8.50	8.52	8.51	1.31	1.29	1.30	0.40	0.39	0.40	203	198	201	18.0	17.2	17.6	230	237	234
Anola orchard	8.71	8.60	8.66	1.33	1.30	1.32	0.39	0.42	0.41	200	201	201	17.2	16.8	17.0	225	229	227
Mean	8.47	8.50	8.49	1.31	1.29	1.30	0.40	0.41	0.41	202	201	202	17.7	17.2	17.4	231	234	233
Forest land use system																		
Sisal	8.3	8.22	8.26	1.28	1.27	1.28	0.41	0.45	0.43	202	211	207	16.7	16.7	16.7	245	245	245
Eucalyptus	8.72	8.61	8.67	1.33	1.35	1.34	0.35	0.36	0.36	187	187	187	14.8	14.8	14.8	240	240	240
Oak	8.31	8.4	8.36	1.30	1.32	1.31	0.36	0.37	0.37	191	191	191	18.1	18.1	18.1	275	275	275
Teak	8.4	8.31	8.36	1.30	1.29	1.30	0.39	0.40	0.38	199	199	199	16.0	16.0	16.0	240	240	240
Mean	8.43	8.38	8.41	1.30	1.31	1.31	0.38	0.40	0.39	195	197	196	16.4	16.4	16.4	250	250	250

Where, RWCS- Rice wheat cropping system; LBCS- Legume based cropping system and VBCS- Vegetable based cropping system.

use system less disturbance of soil by heavy machinery that results lower bulk density (Das *et al.* 2020). The highest SOC 0.40% was recorded under LBCS and lowest SOC 0.35% was found under RWCS. Mango orchard registered maximum SOC 0.42% whereas, minimum SOC 0.40 % was noticed under bael orchard. Maximum SOC 0.43% was found under sisal forest and minimum SOC 0.36 % was registered under eucalyptus forest. The higher SOC in plantation land use system recorded compared to other land use system because more leaves fall occurred and after their decomposition it adds organic matter in soil (Sahoo *et al.* 2019). Maximum available N 201 kg/ha and P 17.3 kg/ha was recorded under LBCS but lowest available N 176 kg/ha and P 14.4 kg/ha was found under RWCS. The highest amount of available N 205 kg/ha and P 17.8 kg/ha was noticed under mango orchard and lowest available N 201 kg/ha and P 17.0 kg/ha was registered under aonla orchard. Sisal forest recorded maximum available N 207 kg/ha but lowest available N 187 kg/ha was registered under eucalyptus forest. Whenever, maximum available P was recorded under oak forest and minimum available P was found under eucalyptus forest. The highest available N and P in soil was recorded under plantation land use system because of enough amount of leaf fall occurred which add organic matter in soil after decomposition and release available nutrients in the soil (Babu *et al.* 2020). LBCS registered higher available K 245 kg/ha and lowest available K 236 kg/ha was recorded under VBCS. However, maximum available K 238 kg/ha was noticed under mango orchard and lowest available K 227 kg/ha was found under aonla orchard. Whereas, among the forest land use system,

oak forest was observed higher available K 275 kg/ha but lowest value of available K 240 kg/ha was registered under teak and eucalyptus forest. It might be due to forest land use system add twigs and leaf litter in the soil which are the rich source of K and after their decomposition add OM as well as release sufficient amount of K in soil solution (Singh *et al.* 2020).

LBCS were found with highest population of bacteria 4.38 CFU/g of soil $\times 10^5$, fungi 1.36 CFU/g of soil $\times 10^4$ and actinomycetes 0.87 CFU/g of soil $\times 10^3$ in soil followed by VBCS but minimum population of bacteria 4.07 CFU/g of soil $\times 10^5$, fungi 1.15 CFU/g of soil $\times 10^4$ and actinomycetes 0.81 CFU/g of soil $\times 10^3$ was recorded under RWCS. Maximum population of bacteria 4.66 CFU/g of soil $\times 10^5$, fungi 1.34 CFU/g of soil $\times 10^4$ and actinomycetes 0.97 CFU/g of soil $\times 10^3$ were observed in mango orchard, whereas the lowest population of bacteria 4.39 CFU/g of soil $\times 10^5$, fungi 1.20 CFU/g of soil $\times 10^4$ and actinomycetes 0.92 CFU/g of soil $\times 10^3$ was registered under aonla orchard. Highest population of bacteria 4.87 CFU/g of soil $\times 10^5$, fungi 3.27 CFU/g of soil $\times 10^4$ and actinomycetes 1.12 CFU/g of soil $\times 10^3$ was found under sisal forest but lowest population of bacteria 4.64 and 4.60 CFU/g of soil $\times 10^5$, fungi 3.13 and 3.09 CFU/g of soil $\times 10^4$ and actinomycetes 1.05 and 1.03 CFU/g of soil $\times 10^3$ was registered under teak and eucalyptus forest, respectively (Table 2). The higher microbial population was found under forest land use system because higher pore space and organic material added to the soil through leaf litter which serves as a source of energy and food for microbial population which ultimately enhanced the

Table 2 Effect of different land uses systems on microbial population of soil

Different land use system	Bacteria (CFU/g of soil $\times 10^5$)			Fungi (CFU/ g of soil $\times 10^4$)			Actinomycetes (CFU/ g of soil $\times 10^3$)		
	Kharif	Rabi	Mean	Kharif	Rabi	Mean	Kharif	Rabi	Mean
<i>Crop land use system</i>									
RWCS	4.12	4.01	4.07	1.17	1.12	1.15	0.83	0.79	0.81
LBCS	4.48	4.28	4.38	1.40	1.31	1.36	0.88	0.86	0.87
VBCS	4.21	4.21	4.21	1.34	1.19	1.27	0.85	0.83	0.84
Mean	4.27	4.17	4.22	1.30	1.21	1.26	0.85	0.83	0.84
<i>Plantation land use system</i>									
Mango orchard	4.71	4.6	4.66	1.36	1.31	1.34	0.98	0.96	0.97
Bael orchard	4.54	4.51	4.53	1.23	1.22	1.23	0.94	0.92	0.93
Anola orchard	4.41	4.37	4.39	1.22	1.18	1.20	0.93	0.91	0.92
Mean	4.55	4.49	4.52	1.27	1.24	1.26	0.95	0.93	0.94
<i>Forest land use system</i>									
Sisal	4.91	4.82	4.87	1.72	4.82	3.27	1.13	1.11	1.12
Eucalyptus	4.65	4.54	4.60	1.63	4.54	3.09	1.05	1.01	1.03
Oak	4.85	4.77	4.81	1.69	4.77	3.23	1.09	1.05	1.07
Teak	4.67	4.61	4.64	1.64	4.61	3.13	1.07	1.02	1.05
Mean	4.77	4.69	4.73	1.67	4.69	3.18	1.09	1.05	1.07

Where, RWCS- Rice wheat cropping system; LBCS- Legume based cropping system and VBCS- Vegetable based cropping system.

microbial population and activity in soil (Paramesh *et al.* 2020).

SUMMARY

Based on the findings of present investigation, it can be inferred that physico-chemical properties and microbial population in soil was also varied with land use whereas the physico-chemical properties and microbial population were generally improved in *kharif* as compared to *rabi*. Plantation land use was the best land use system followed by forest land use system for sustainable improvement of soil health may be recommended in the eastern region of Uttar Pradesh or similar agro ecoregions.

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