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Physico-chemical properties and organic carbon stock in a Vertisol as influenced by different land use systems

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Abstract
The present study was conducted at farmer's fields under the guidance of Department of forestry, JNKVV, Jabalpur, Madhya Pradesh during the year 2015-2016 to evaluate physico-chemical properties and SOC stock under different nine land use systems (viz., four sole cropping land use namely paddy-wheat sole cropping, soybean-mustard sole cropping, moong - wheat sole cropping, pigeonpea sole cropping, one eucalyptus sole plantation, and four agrisilviculture land uses- eucalyptus+ paddy-wheat agrisilviculture, eucalyptus + soybean-mustard agrisilviculture, eucalyptus + moong - wheat agrisilviculture, eucalyptus + pigeonpea agrisilviculture) at three soil depth (0-15, 15-30 and 30-45 cm). The study revealed that, soil pH and EC were not influenced statistically by different land use system. However, Physico-chemical properties (viz., OC, bulk density and available N, P, & K) and SOC were influenced by different land use systems. Significantly highest available N, P, K and SOC stock was observed under Eucalyptus + pigeonpea agrisilviculture system (T_9) and lowest was under moong-wheat conventional cropping land use system (T_3). Theses soil parameters gradually decreased with successive increasing soil depths. But soil bulk density revealed reversed trend and it was significantly highest under moong-wheat conventional cropping (T_3) and lowest was under eucalyptus + pigeonpea agrisilviculture (T_9) land use system at all the soil depths and also increased with successive decreasing soil depths The correlation study showed that, the OC (%), EC, available N, P and K exhibited highly positive significant correlations with soil organic carbon (SOC) stock, while the soil pH and bulk density had highly negative significant correlations with SOC stock.

Keywords: Physico-chemical properties, SOC stock, conventional cropping, agrisilviculture land use system

Introduction

Land use systems with more than one component have a distinct advantage which led to the adoption of diversified land-use systems such as agroforestry, agrisilviculture, Alley cropping and so on, apart from conventional agriculture, by the farming community. These diversified land-use systems not only help the farmers in providing assured income but also protect the land from degradation and enhance the physico-chemical quality of soil. Soil has three important properties i.e, physical, chemical and biological, which makes it functionally complete resources (Abera and Meskel 2013) [1]. The inherent characteristics of soil which are mainly the resultant of parent material and climate conditions due to different land use management practices. Soil properties such as pH, electrical conductivity, soil organic carbon, bulk density and nutrient status tend to change depending on land use, climate and vegetation cover.

Soil plays an important role in global carbon cycle as it contains around three times more C than in atmosphere and 3.8 times more C than in biotic pool (Batjes and Sombroek, 1997) [3]. Land management with less soil disturbance increased higher SOC accumulation, while intensive disturbance decreased SOC accumulation. It constitutes one of the most complex components of such terrestrial ecosystems. Organic matter plays vital role in regulating the flow and supply of plant nutrients and water flow, and determining physical properties of soils (Cotrufo *et al*., 2011) [7].

The enrichment of soil properties depends on the tree species, management practices and the quantity and quality of litter and their decay rate. Tree based land use system contribute a lot of organic matter to soil in the form of leaves, twings, stem and flower in the formation of organic matter and release of different nutrients (Rahangdale *et al*., 2014) [27].

In the present study, Eucalyptus clone were planted in paired row with different cropping sequence. The leaf litter deposition from Eucalyptus resultant soil acidity might also affected intercrop yield. Owing to these negative effects, the positive effects like increased organic matter content from leaf litter decomposition might have resulted in improvement in soil water holding capacity, porosity, texture, essential nutrient and yield improvement of Kharif and Rabi crop. Eucalyptus plantation results in improvement in soil nutrient (N, P, K, and organic matter) as compared to natural soil (Jan *et al*., 1996) [14]. Keeping above facts in mind present study carried out to explore the physical, chemical and SOC stocks of a Vertisol under different land use systems to provide appropriate management intervention for sustainable utilization.

Materials and Methods

The study was carried out in 2015-16 at the farmer's fields under the guidance of Department of forestry, JNKVV, Jabalpur, Madhya Pradesh. Geographically, the experimental site is located between 22°49' to $24^0$8' North Latitude and $78^0$21' to $80^0$58' East Longitude with an average altitude of 381.30 meters above the mean sea level. During the study total nine land uses systems were studied (Five conventional cropping land use systems viz., paddy-wheat sole cropping, soybean - mustard sole cropping, moong -wheat sole cropping, pigeonpea sole cropping, eucalyptus sole plantation, and four agrisilviculture land use practices viz., eucalyptus + paddy-wheat agrisilviculture, eucalyptus + soybean-mustard agrisilviculture, eucalyptus + moong- wheat agrisilviculture, eucalyptus + pigeonpea agrisilviculture at three soil depth (0-15, 15-30 and 30-45 cm) for comparing nutrient status and organic carbon stock in soils with four replication in completely randomized block design (CRBD). Plot size of 20 x 8 m for different land use systems were taken for soil sampling. Composite soil samples were collected separately from 0-15, 15-30 and 30-45 cm depth with the help of core sampler from all the plots. Samples were air dried in shade, grinded with wooden pestle, passed through 2 mm sieve and stored in poly bags for further laboratory analysis. The soil pH and electrical conductivity were determined in soil: distilled water suspension (1:2). The organic carbon by partial oxidation method (Walkley and Black, 1934) [34], the available N in the soil was determined by alkaline permanganate method (Subbiah and Asija, 1956) [32], available P by sodium bicarbonate method (Olsen *et al*., 1954) [22] and available K by neutral normal ammonium acetate method (Jackson 1973) [25]. The soil bulk density was determined by using the metal core sampler method. Soil organic carbon stocks were calculated by multiplying the organic carbon with weight of the soil (bulk density and depth) for a particular depth and expressed in t ha^{-1} as suggested by Pearson *et al,* (2007) [25].

C (t ha^{-1}) = soil bulk density (g/cm^3) × soil depth (cm) × % C

Conversion of soil organic carbon to CO_2 the final results were multiplied by a factor of 3.67 (i.e. the molecular mass of CO_2/ atomic mass of C) to convert the total carbon stored to carbon dioxide sequestration potential in soil. The experimental data were subjected to the statistical analysis as per the procedure suggested by Panse and Sukhatme (1967) [24].

Results and discussion

Soil pH and Electrical conductivity (EC)

Different land use system showed non-significant effect on soil pH and Electrical conductivity at different soil depths viz., 0-15, 15-30 and 30-45 cm (Table-1).

Table 1: Impact of different land use systems on soil pH, EC, OC (%) and Bulk density**.**

Land use systems	Soil pH			Electrical conductivity (dS/m^2 at 25 ^0C)			Organic carbon (%)			Soil Bulk Density (g/cm^3)		
	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
T1- Paddy-wheat conventional cropping	7.40	7.48	7.65	0.190	0.176	0.157	0.750	0.690	0.605	1.370	1.413	1.463
T2- Soybean-mustard conventional cropping	7.30	7.40	7.55	0.200	0.185	0.164	0.728	0.665	0.590	1.383	1.430	1.475
T3- Moong-wheat conventional cropping	7.35	7.45	7.64	0.193	0.178	0.158	0.713	0.645	0.580	1.393	1.438	1.480
T4- Pigeonpea conventional cropping	7.26	7.30	7.53	0.196	0.180	0.160	0.765	0.695	0.625	1.370	1.405	1.450
T5- Eucalyptus sole plantation	7.28	7.38	7.50	0.195	0.184	0.162	0.815	0.750	0.655	1.313	1.378	1.420
T6- Eucalyptus+paddy-wheat agrisilviculture	7.24	7.33	7.48	0.203	0.188	0.164	0.915	0.780	0.705	1.303	1.338	1.388
T7- Eucalyptus+ soybean-mustard agrisilviculture	7.18	7.27	7.39	0.210	0.193	0.168	0.835	0.763	0.688	1.338	1.358	1.408
T8- Eucalyptus+moong-wheat agrisilviculture	7.21	7.30	7.45	0.204	0.189	0.165	0.870	0.798	0.710	1.328	1.345	1.390
T9- Eucalyptus+ pigeonpea agrisilviculture	7.15	7.22	7.34	0.208	0.190	0.165	0.965	0.878	0.773	1.280	1.318	1.350
SEm±	0.12	0.09	0.10	0.008	0.009	0.006	0.010	0.008	0.009	0.008	0.012	0.008
Land use system (L) CD at 5%	NS	NS	NS	NS	NS	NS	0.030	0.023	0.026	0.024	0.035	0.027

Organic carbon (%)

The mean data pertaining to variation in soil organic carbon (OC) percent under different land use systems were presented in Table-1. Different land use system showed significant variation in organic carbon percent at different soil depths viz., upper depth (0-15 cm), middle depth (15-30 cm) and lower depth (30-45 cm). The significantly highest organic carbon (%) was found under eucalyptus+pigeonpea agrisilviculture (T_9) followed by eucalyptus+paddy-wheat agrisilviculture (T_6), eucalyptus+moong-wheat agrisilviculture (T_8), which were at par but significantly superior to eucalyptus+soybean-mustard agrisilviculture (T_7), eucalyptus sole plantation (T_5), pigeonpea conventional cropping (T_4), paddy-wheat conventional cropping (T_1) and soybean-mustard conventional cropping (T_2). Lowest organic carbon percent was found under moong-wheat conventional cropping (T_3) land use system at all the soil depths. In the present study, the soil enrichment in SOC content (%) under tree based systems as compared to conventional cropping systems. This may be due to several factors such as addition of litter, annual fine root biomass recycled and root exudates and its reduced oxidation of organic matter under tree shades (Gill and Burman, 2002) [10]. The probable reason of higher OC (%) in Eucalyptus+pigeonpea agrisilviculture may be presence of legume (pigeonpea) crop in the field for longer period as compared to other crops and cause addition of crop litter. There are several reports that root biomass under agrisilviculture system is generally higher than sole cropping (Sharma *et al*., 2009) [28]. Generally, the trees with lignified cell in its plant parts like litter, bark, small branches, roots, etc. may leads to biochemical stabilization of organic carbon in the soil and leads to improve SOC under agroforestry as concluded by Six *et al*., (2002) [31]. Hence, one of the reason, which reveals the lower concentration of SOC under sole cropping (without tree), is lack of lignified cells in agricultural residues. The large scale tillage and cultural operation may be another cause to reduce the organic carbon percent under the sole cropping with full exposure to sun. The results are also in conformity with the finding of Pingle (2009) [26] and Ghimire (2010) [9]. It was also inferred from the study, the organic carbon percent was gradually decreased with successive increasing soil depths. Hence, OC percent was more in upper soil depth as compared to lower soil depths. This may be attributed to the major contribution made by litter fall at upper surface. Similar variation in OC with soil depth has been reported by Kaur and Puri (2013) [15], Singh *et al*, (2014) [30] and Bisht and Bangarwa (2015) [5].

Soil bulk density (g/cm^3)

Different land use systems showed significant variation in bulk density at different soil depths viz., 0-15, 15-30 and 30-45 cm (Table 2). Significantly highest bulk density was found under moong-wheat conventional cropping (T_3) land use system, which were at par with soybean-mustard conventional cropping (T_2) and significantly superior to paddy-wheat conventional cropping (T_1), pigeonpea conventional cropping (T_4), eucalyptus+soybean-mustard agrisilviculture (T_7), eucalyptus+moong-wheat agrisilviculture (T_8). Significantly lowest bulk density was observed under eucalyptus+pigeonpea agrisilviculture (T_9) land use system, which were at par with eucalyptus sole plantation (T_5) and eucalyptus+paddy-wheat agrisilviculture (T_6) at all the soil depths. In general, it was also inferred from the study, the bulk density was increased with successive increasing soil depths. In the present study, the soil of conventional agricultural land use systems revealed relatively higher bulk density than eucalyptus based agrisilviculture practices and eucalyptus sole plantation, which might be due to the effects of high compaction of soil, more intensity of tillage operation and lack of organic matter (litter). The low bulk density in eucalyptus-pigeonpea agrisilviculture practice is attributed due to presence of relatively high amount of organic matter. Such inverse relationship of the bulk density and SOC content was also reported by Sharma *et al*., (2015) [29] and Mhawish (2015) [19]. Nayak *et al*., (2009) [21] also observed lower bulk density under *Prosopis juliflora* based agroforestry land use system as compared to control.

Table 2: Impact of different land use systems on available nutrients.

Land use systems	Available Nitrogen (kg ha^{-1})			Available Phosphorus (kg ha^{-1})			Available Potassium (kg ha^{-1})		
	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
T1- Paddy-wheat conventional cropping	281.53	265.28	251.91	28.65	27.34	23.19	226.45	218.90	199.87
T2- Soybean-mustard conventional cropping	273.32	260.35	245.22	27.66	24.99	22.59	224.13	214.00	192.78
T3- Moong-wheat conventional cropping	272.50	255.03	242.73	26.24	24.76	20.99	215.68	205.58	189.47
T4- Pigeonpea conventional cropping	284.16	268.45	253.87	28.21	25.64	23.14	220.28	214.32	197.49
T5- Eucalyptus sole plantation	275.43	268.13	251.24	27.20	25.22	22.99	226.23	218.67	200.30
T6- Eucalyptus+paddy-wheat agrisilviculture	287.48	274.28	266.05	32.11	29.75	26.31	238.51	235.43	217.87
T7- Eucalyptus+ soybean-mustard agrisilviculture	285.95	269.15	256.15	30.90	27.92	24.96	230.44	222.67	208.16
T8- Eucalyptus+moong-wheat agrisilviculture	286.49	270.36	257.04	31.51	28.82	25.07	233.32	226.38	208.99
T9- Eucalyptus+ pigeonpea agrisilviculture	299.55	280.53	267.24	33.86	32.23	26.98	245.33	237.77	220.47
SEm±	1.49	3.14	3.14	0.40	0.45	0.51	2.02	2.34	2.50
Land use system (L) CD at 5%	4.34	9.15	9.16	1.17	1.33	1.49	5.90	6.82	7.29

Available nitrogen (kg ha^{-1})

Available nitrogen in soil under different land use systems showed significant variation at different soil depths viz., upper depth (0-15 cm), middle depth (15-30 cm) and lower depth (30-45 cm) (Table-3). Significantly highest available nitrogen was found under eucalyptus+pigeonpea agrisilviculture (T_9) land use system followed by eucalyptus+paddy-wheat agrisilviculture (T_6), eucalyptus+moong-wheat agrisilviculture (T_8), which were at par and superior to eucalyptus+soybean-mustard agrisilviculture (T_7), pigeonpea conventional cropping (T_4), paddy-wheat conventional cropping (T_1) and eucalyptus sole plantation (T_5). Significantly lowest available nitrogen was recorded under moong-wheat conventional cropping (T_3) land use system at par with soybean-mustard conventional cropping (T_2) at all the soil depths. The increase in available nitrogen content of soil under Eucalyptus+pigeonpea agrisilviculture system is attributed due to addition of more organic matter in soil in the form of litter fall and fine root biomass as well as the fixing atmospheric nitrogen by pigeonpea. The mineralization of organic matter release nutrient in soil (Osman *et al*., (2001) [23]. Chaudhary *et al*., (2007) [6] also reported the similar results in case of poplar based agrisilviculture system. However, the significant decrease in available nitrogen under moong-wheat conventional cropping and other conventional cropping land use system may be due to more nitrogen uptake per unit area. In the present study, available nitrogen content also decreased with each successive soil depths i.e., from 0-15 to 30-45 cm and more available nitrogen was recorded in 0-15 cm soil depth. The maximum amount of available nitrogen in upper soil depth may be due to more turn over and addition of organic residues on surface soil which decreased with depth. Bhardwaj *et al*., (2001) [4] also recorded decreasing trend in available nitrogen content with increase in soil depth under poplar based agroforestry systems. Kaur and Puri (2013) [15], Singh *et al*, (2014) [30] and Bisht and Bangarwa (2015) [5] also reported the similar results.

Table 3: Zero order correlation matrix of soil organic carbon (SOC) stock with different physico-chemical properties of soil under different land use systems.

Variables	Physico-chemical properties of soil						SOC stock (t ha^{-1})
	Electrical conductivity (ds/m^2 at 25 ^{0}C)	Organic carbon (%)	Bulk density (g/cm^3)	Avail. N (Kg ha^{-1})	Avail. P (Kg ha^{-1})	Avail. K (Kg ha^{-1})	
	X_2	X_3	X_4	X_5	X_6	X_7	Y
X_1- Soil pH	-0.909**	-0.849**	0.829**	-0.790*	-0.773*	-0.740*	-0.862**
X_2- Electrical conductivity	-	0.750*	-0.733*	0.636 ^{NS}	0.722*	0.701*	0.768*
X_3- Organic carbon (%)	-	-	-0.991**	0.933**	0.961**	0.955**	0.998**
X_4- Bulk density (g/cm^3)	-	-	-	-0.912**	-0.937**	-0.945**	-0.984**
X_5- Avail. N (Kg ha^{-1})	-	-		-	0.957**	0.945**	0.936**
X_6- Avail. P (Kg ha^{-1})	-	-	-	-	-	0.988**	0.965**
X_7- Avail. K (Kg ha^{-1})	-	-	-	-	-	-	0.956**

Note: ^{NS,} * and ** sign indicate significant at 0.05 and 0.01 level of significance respectively.

Available phosphorus (kg ha^{-1})

Significantly highest available phosphorus was found under eucalyptus+pigeonpea agrisilviculture (T_9) followed by eucalyptus+paddy-wheat agrisilviculture (T_6), eucalyptus+moong-wheat agrisilviculture (T_8), which were at par but significantly superior to eucalyptus+soybean-mustard agrisilviculture (T_7), paddy-wheat conventional cropping (T_1), pigeonpea conventional cropping (T_4), soybean-mustard conventional cropping (T_2) and eucalyptus sole plantation (T_5). Significantly lowest available phosphorus was observed under moong-wheat conventional cropping (T_3) land use system at all the soil depths. The highest available phosphorus under Eucalyptus + pigeonpea based agrisilviculture land use systems may be due to higher acidic phosphatase activity as compared other agrisilviculture and conventional land use systems. As the organic anion exudation and acidic phosphatase activity of tree and pigeonpea roots was found mobilization of P under Eucalyptus+pigeonpea based agrisilviculture. There was decrease in available P under conventional cropping probably may due more nutrient uptake of nutrient and lower addition of organic matter in soil. In general, it was also seen from the results the available phosphorus in soil was decreased with successive increasing soil depths. The available phosphorus decreased with each successive increase in soil depth and is in conformity with findings of several workers viz., Ghimre (2010) [9], Kaur and Puri (2013) [15], Singh *et al*., (2014) [30], and Bisht and Bangarwa (2015) [5].

Available potassium (kg ha^{-1})

Present study also conferred significant variation in available potassium at different soil depths. Significantly highest available potassium was found under eucalyptus+ pigeonpea agrisilviculture (T_9) land use, which were at par with eucalyptus+ paddy-wheat agrisilviculture (T_6) but significantly superior to eucalyptus+ moong-wheat agrisilviculture (T_8), eucalyptus+ soybean-mustard agrisilviculture (T_7), paddy-wheat conventional cropping (T_1), eucalyptus sole plantation (T_5) and soybean-mustard conventional cropping (T_2). However, significantly lowest available potassium was observed under moong-wheat conventional cropping (T_3) at par with pigeonpea conventional cropping (T_4) land use system at all the soil depths. The increase in available potassium content of soil under Eucalyptus+ pigeonpea agrisilviculture system is attributed to addition of more organic matter in soil in the form of litter fall and fine root biomass. The mineralization of organic matter release nutrient in soil (Osman *et al*, (2001) [23]. However, the significant decrease in available potassium under moong-wheat conventional cropping and other conventional cropping land use system may be due to more potassium uptake per unit area. Chaudhary *et al*., (2007) [6] also reported the similar results in case of poplar based agrisilviculture system. In general, it was also inferred from the present study that, the available potassium was decreased with successive increasing soil depths as consequences of higher litter fall and fine root turnover at surface layer. Similar decrease with soil depths has also been reported by Kaur and Puri (2013) [15], Singh *et al*, (2014) [30] and Bisht and Bangarwa (2015) [5].

Soil organic carbon (SOC) stock (t ha^{-1})

In the present study, soil organic carbon stock under different land use systems was found significant at all soil depths (Figure 1). Eucalyptus + pigeonpea agrisilviculture (T_9) land use system observed significantly highest SOC stock at par with eucalyptus + paddy-wheat agrisilviculture (T_6) but significantly superior to eucalyptus + moong-wheat agrisilviculture (T_8), eucalyptus + soybean-mustard agrisilviculture (T_7), eucalyptus sole plantation (T_5) and pigeonpea conventional cropping (T_4). However, significantly lowest SOC stock was observed under moong-wheat conventional cropping (T_3) at par with soybean-mustard conventional cropping (T_2) and paddy-wheat conventional cropping (T_1) land use system at all the successive soil depths. The highest SOC stock under eucalyptus+ pigeonpea agrisilviculture systems may have happened because of enhanced accumulation of leaf litter in tree based land use systems. The abundant litter and or pruned biomass return to soil, combined with the decay of root, contribute to the improvement of organic matter under complex land use systems (Kumar *et al*, 2001) [17]. Low amount of soil organic carbon stock under the conventional agriculture land systems can be ascribed to intensive cropping as also reported by Gupta and Sharma (2014) [11], Mohammed and Bekele (2014) [20], Mangalassery *et al*, (2014) [18] and Wang *et al*, (2015) [35]. It was also revealed from the study, the SOC stock was decreased with successive increasing soil depths. Maximum was recorded in the upper soil depth (0-15 cm), while the minimum was at lower soil depth (30-45 cm). The increase or decrease in SOC stock was associated with bulk density and organic carbon content of soil at a particular soil depth. The higher amount of SOC stock in upper soil depth i.e., 0-15 cm may be explained in the sense that, there is continuous accumulation of leaf litter on the surface layer which keep on decomposing and thus enrich the upper layer continuously. These results are in conformity with the finding of Arora *et al*, (2013) [2]. Carbon stock is also intricately linked with site quality, nature of land use, choice of species and other management practices adopted, which explains the varying carbon stock in different land use management and also at different soil depths. This in turn is due to the effect of differential litter addition in different land uses (Swamy *et al*, 2003) [33]. Thus accumulation of SOC stock in different land uses through litter fall is different that might have been regulated due to varying organic matter decomposition and the formation of stable and labile soil organic matter pool in these land uses. He *et al*., (2013) [12] and Gelaw *et al*, (2014) [8] also reported the same results.

Zero order correlation studies of soil organic carbon (SOC) stock with different physico-chemical properties of soil under different land use systems

Zero order correlation matrix of SOC stock with different physico-chemical properties of soil under different land use systems were furnished in Figure 1 (Soil depth 0-45 cm). From the results, it was observed that, different physico-chemical properties viz., the electrical conductivity, organic carbon percent, available N, available P and available K provided highly significant positive correlations with soil organic carbon (SOC) stock, while the soil pH and bulk density yielded highly significant negative correlations with soil organic carbon (SOC) stock at 1 % level of significance. It was further added that, the soil pH gave significant negative correlations with electrical conductivity, organic carbon percent available N, available P and available K, while the significant positive correlation was yielded in case of bulk density with SOC stock at 1 % level of significance. The electrical conductivity yielded significant positive correlations with organic carbon percent, available P and available K, while in the case of bulk density significant negative correlation was observed at 5 % level of significance. The organic carbon percent provided highly significant positive correlations with available N, available P and available K, while in the case of bulk density highly significant negative correlation was observed at 1 % level of significance. The bulk density provided highly significant negative correlations with available N, available P and available K at 1 % level of significance. The available N yielded highly significant positive correlations with available P and available K. Similarly, available P yielded highly significant positive correlation with available K also at 1 % level of significance. The results were also confirmed with the finding of Koul and Panwar (2012) [16].

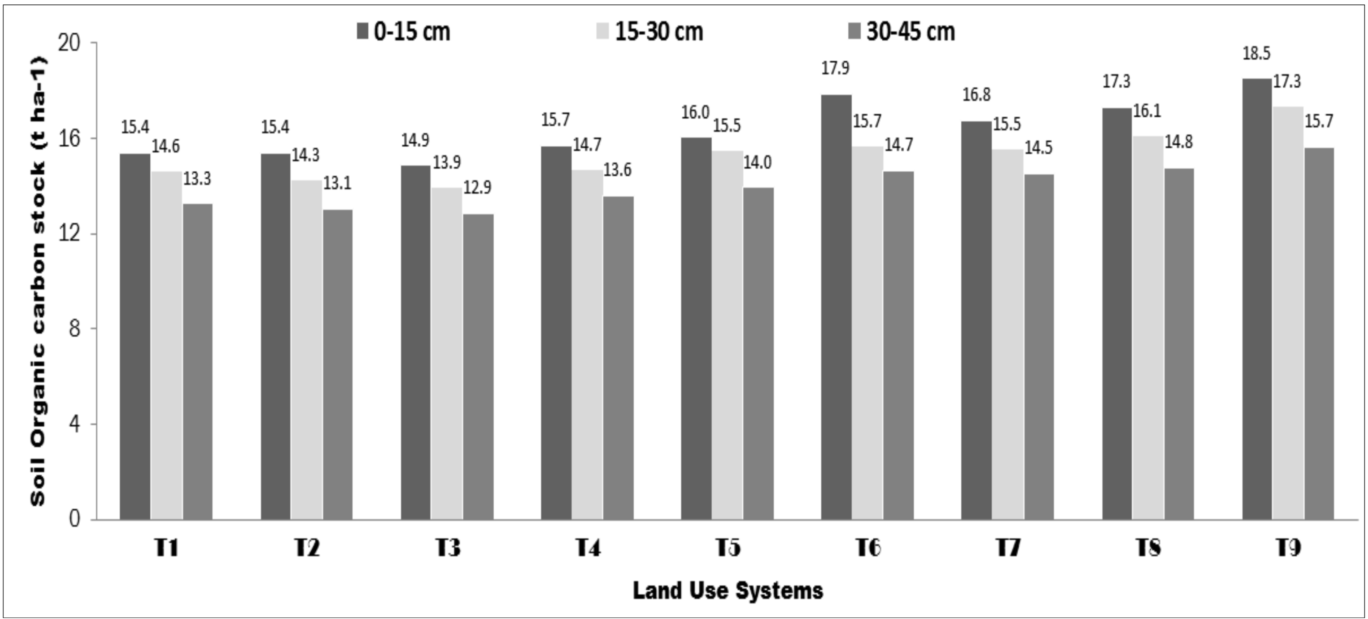

Fig 1: Soil organic carbon stock under different land use systems

Conclusion

From the present study, it was concluded that, the physico-chemical properties (viz., OC, bulk density and available N, P, & K) and SOC were influenced by different land use systems. Eucalyptus + pigeonpea agrisilviculture system (T_9) land use system observed significantly highest available N, P, K and SOC stock as compared to other land use systems. While, the lowest was under moong-wheat conventional cropping land use system (T_3). Theses soil parameters gradually decreased with successive increasing soil depths. But soil bulk density revealed revered trend, significantly highest bulk density was found under moong-wheat conventional cropping (T_3) and lowest was under eucalyptus + pigeonpea agrisilviculture (T_9) land use system at all the soil depths and also increased with successive decreasing soil depths The correlation study showed that, the OC (%), EC, available N, P and K exhibited highly positive significant correlations with soil organic carbon (SOC) stock, while the soil pH and bulk density had highly negative significant correlations with SOC stock.

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