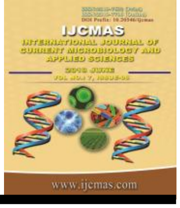
Int.J.Curr.Microbiol.App.Sci **(2018) 7(6): 2659-2671**

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 7 Number 06 (2018)**
Journal homepage: http://www.ijcmas.com



Original Research Article https://doi.org/10.20546/ijcmas.2018.706.315

Effect of Land-uses on Physico-Chemical Properties and Nutrient Status of Surface (0-15 cm) and Sub-Surface (15-30 cm) Layers in Soils of South-Western Punjab, India

Agniva Mandal*, A. S. Toor and S. S. Dhaliwal

Department of Soil Science, Punjab Agricultural University, Ludhiana-141004, Punjab, India

**Corresponding author*

A B S T R A C T

The present study was conducted to assess the effect of three agricultural land-uses viz. cropland, horticultural land and uncultivated land on soil quality and fertility status. Soil samples were collected from south-western plains of Punjab which is classified under semi-arid climate. Samples were analysed for assessment of some selected soil physico-chemical properties as well as macro and micro nutrient status. Results of the investigation reported that soil samples of the study area are slightly alkaline and non-saline in nature. Textural class observed as sandy loam in cropland and horticultural land while it was loamy sand under uncultivated land. Highest water stable aggregate (WSA) percentage was recorded under horticultural land and least was in case of uncultivated land at both 0-15 and 15-30 cm depths. Depth-wise increase in soil aggregation was also noted. Horticulture had highest soil organic carbon (SOC) concentration both in surface (8.91 g kg soil^{-1}) and sub-surface soil (5.75 g kg soil^{-1}). Available nitrogen (N) content followed a trend horticulture > cropland > uncultivated land but a different trend of cropland > horticultural land > uncultivated land was found in case of phosphorus (P) and potassium (K) availability in surface soil. In both soil depths cropland and horticultural land were found statistically at par with respect to available N, P and K contents. Highest available micro-nutrients were recorded under horticulture which was measured lowest in case of uncultivated land. All the macro and micro nutrients exhibited significant positive correlation among themselves. Negative correlation between SOC and BD (r = - 0.096) was observed while WSA was found highly correlated with SOC (r = 0.681, p = 0.01) and clay content (r = 0.681, p = 0.01). Micro-nutrients also exhibited significant positive correlation both with clay content and SOC.

Keywords

Land-uses, soil quality, soil fertility, physico-chemical properties, soil nutrient status

Article Info

Accepted:
20 May 2018
Available Online:
10 June 2018

Introduction

Due to continuous degradation of natural resources maintenance of sustainability of environment has become a serious concern in recent years. A system is considered sustainable when it improves or maintains the quality of lithosphere, hydrosphere and atmosphere. Soil is an important non-renewable natural resource which has to be kept productive and healthy as because a major part of agricultural productivity depends on it. The main objective of sustainable agriculture is to maintain or improve the productivity without hampering the soil quality. Soil quality may be defined as capacity of soil to promote plant growth and development, to maintain ecological productivity and to sustain environment. Along with the plant growth promoting properties, a good quality soil is also capable of preventing air and water pollution, soil erosion and land degradation (Reganold, 1995). So, assessment of soil quality should be considered as one of the important issues to maintain both agricultural and environmental sustainability (Karlen *et al.,* 2008). Different agricultural land-uses greatly influence soil quality and physico-chemical properties (Paz-Kagan, *et al.*, 2014) and affect the nutrient dynamics and supply (Murty *et al.,* 2002; Jiang *et al.*, 2002). Due to rapid conversion of natural ecosystems into human driven systems knowledge of proper management practices and adoption of suitable land-use systems are highly needed.

The increasing population and socio-economic needs impart pressure on agricultural production system which ultimately leads to unplanned changes in land-use systems (Seto, 2002). So, it is a big deal to meet these necessities through balanced land-uses by keeping the soil fertility intact. The inherent capacity of soil to supply nutrients to plants could be referred as soil fertility. According to Tisdale *et al.,* (1993), soil fertility is the availability status of essential macro and micro nutrients present in the soil. Conversion of land-uses result in change in soil characteristics which in turn affects the soil fertility (Onwudike *et al.,* 2015). Land-use change causes significant alteration of soil reaction, soil organic matter (SOM), nutrient status, soil physical quality and microbial activity in the rhizosphere also (Karlen *et al.*, 2003; Sarawathy *et al.,* 2007). Smith *et al.*, (1995) observed that deforestation and intensive cultivation in the same land results in soil pH and acidifications. Soil organic carbon (SOC) is generally considered as a crucial regulating factor of both soil physical and chemical quality (Cotrufo *et al.,* 2011). Bot and Bnites (2005) noted about 30 per cent loss of SOC due to conversion of natural grassland and forest into cropland. Distribution and availability of phosphorus (P) and other macro-nutrients to a certain extent are also influenced directly by different land–uses, biomass production and level of SOM which is again indirectly affected by land-uses (Genxu *et al.,* 2004). Soil micro-nutrients availability also depends on soil pH, SOM content and several physical, chemical and biological conditions of the rhizosphere. So, land-use changes could alter the soil physico-chemical and biological properties which might be the reason behind the variation of micronutrient availability under different land-use systems (Jiang *et al.*, 2002; Wasihun *et al.*, 2015). Assessment of soil biological activity is also important to maintain the sustainability of ecology of soil. Therefore, the present study was aimed to assess some selected soil physico-chemical properties and nutrient status in order to evaluate the quality of soil under the effect of different agricultural land-uses in south-western plains of Punjab which might also be able to add value to the documentation of the soil fertility status of the study area and provide future line of work.

Materials and Methods

Sampling sites

Soil samples were collected from three sites viz. village Dhanaula (30°18´ N, 75°27´ E) in district Barnala, village Bhucho (30°15´ N, 75°03´ E) and village Phul (30°19´ N, 75°14´ E) in district Bathinda of north Indian state of Punjab (Figure 1). Soil samples were taken from three land-uses viz. cropland, horticulture and uncultivated land. In cropland systems, soil samples were collected under cotton-wheat cropping system. Horticultural systems were characterized by tree stand of Guava and Kinnow. On the other hand, uncultivated lands were generally comprised of patches of naturally growing grasses and weeds (viz. *Cynodon dactylon*, *Cyperus rotundus*, *Parthenium hysterophorus*, *Cleome viscosa* etc.). On an average, all the land-uses were more than 10 years old.

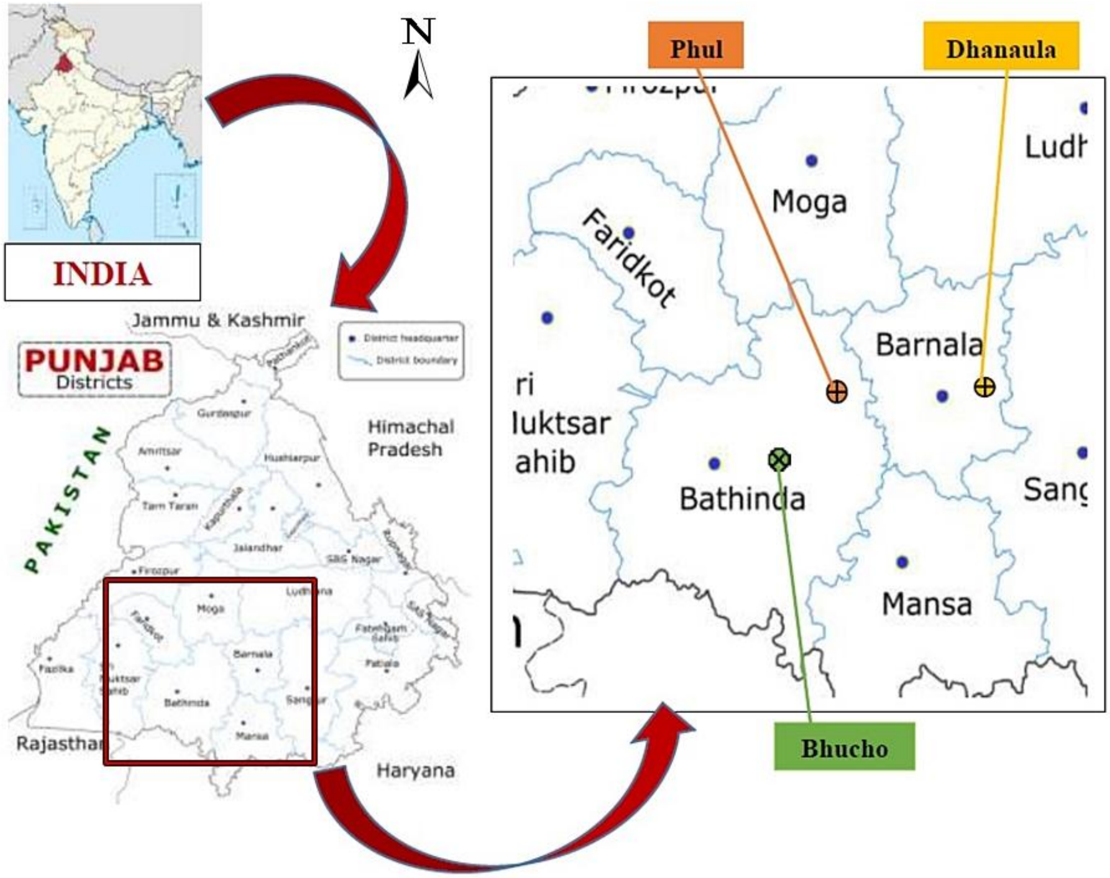


Fig.1 Locations of soil sampling sites of south-western plains of Punjab, India

Soil sampling and analysis

Soil samples were collected from three spots randomly chosen under each specific land-uses from 0-15 and 15-30 cm depths with the help of auger. All the samples were brought to the laboratory and air dried. Determination ofthe soil pH was made from 1:2 soil: water suspension with the help of Elico-glass electrode pH meter (Jackson, 1967). The electrical conductivity of soil samples were recorded from 1:2 soil: water suspension using Elico conductivity meter (Richard, 1954). Characterization of particle size distribution was done using international pipette method (Gee and Bauder, 1986). Soil bulk density was obtained using core method with the help of metallic cores having inner diameter of 5 cm and 7 cm length. From the middle portion of each of the 4 soil layers (i.e. 0-15, 15-30, 30-60 and 60-90 cm soil layers) the samples were collected. Then collected samples were dried for 24 hours in an oven at 105 °C. After that, the calculation of bulk density was done by dividing dry weight of soil core by the inner core volume and expressed as Mg m^{-3}.Determination of aggregate size distribution expressed in terms of water stable aggregate percentage (WSA) was done using wet sieving method proposed by Yoder (1936). Walkley and Black’s (1934) rapid titration method was performed to estimate soil organic carbon content. The available nitrogen (kg ha^{-1}) in soil samples was recorded by following the alkaline-permanganate method given by Subbiah and Asija (1956). The available phosphorus (kg ha^{-1}) in soil samples was determined by the procedure proposed by Olsen *et al.*, (1954). Available potassium (kg ha^{-1}) content in soil samples was estimated by extracting with neutral normal ammonium acetate and determined on a Flame Photometer (Merwin and Peech, 1951).Availability of soil micronutrients i.e. iron (Fe), manganese(Mn), zinc(Zn) andcopper (Cu) were estimated by extracting soil samples with diethylenetriamine pentaacetic acid (DTPA) extractant (0.005 M DTPA + 0.01 M $CaCl_2$ + 0.1 M TEA buffer adjusted to pH 7.30) as described by Lindsay and Norvell (1978) and the extract was analyzed with an atomic absorption spectrophotometer (Varian Techtron Model ABQ 775).

Statistical analysis

Analysis of Variance (ANOVA) for Completely Randomized Design (CRD) was used for analyzing the data using SPSS (SPSS Inc., version 16, USA) software. The significance of differences were tested between treatment-means and compared using least significant difference (LSD) values tested at 5 per cent probability level. Correlation analysis was also done to study the relationships among the parameters.

Results and Discussion

Physico-chemical properties of soil

Soils under all three land-uses were slightly alkaline (pH ranges from 7.68-7.98 irrespective of land-uses and depths) and non-saline (EC ranges from 0.32-0.46 dS m^{-1} irrespective of land-uses and depths) in nature (Table 1). Lowest values were recorded in horticultural land in both surface and sub-surface layers of soil in terms of pH and EC. Otherwise, no definite pattern was seen regarding these two parameters. Soils under different land-uses did not differ significantly both in pH and EC. Sand, silt and clay content ranged from 67.17-79.67, 11.67-19.17, 8.67-13.67 per cent respectively irrespective of land-uses and depths. Highest sand content was recorded in case of uncultivated land followed by cropland and horticultural land in case of both surface and sub-soil. On the contrary, both silt and clay contents followed the order horticultural land > cropland > uncultivated land in both 0-15 and 15-30 cm depths (Table 1). Samples of cropland and horticulture were of sandy loam in texture whereas soils of uncultivated lands were characterized as loamy sand.Soil bulk density ranged between 1.36 and 1.65 Mg m^{-3} and a trend of cropland > uncultivated land > horticultural land was observed under both the cases of surface and sub-surface soils. Like our findings Sintayehu (2006) and Lemenih *et al.*, (2005) also found variation of bulk density due to different kind of land-uses. On the contrary, according to the results of Yifru (2011) bulk density was not affected by land-use. Higher input of organic matter may be the reason of lower bulk density in horticulture as compared to other land-uses as negative correlation between soil organic carbon and bulk density was found by many researchers (Jiao *et al.*, 2009; Sakin 2012; Chaudhari *et al.*, 2013). Highest WSA was recorded in case of horticultural land (70.12 %) followed by cropland (58.05 %) and uncultivated land (52.67 %) in surface layer. Similar trend was noted in case of sub-surface soil also (Table 1). Observation says that cropland and uncultivated land exhibit lower aggregate stability than horticulture which may be due to mechanical breakdown of aggregates by tillage and other cultivation practices (Adesodun *et al.*, 2007, Gupta-Choudhuri *et al.*, 2008), impact of raindrop and harvest traffic (Holeplass *et al.*, 2004). On the other hand cultivation decreases more SOC as it exposes SOC to microbial decomposition which results in deterioration in soil aggregation (Mrabet *et al.*, 2001). Thus higher WSA percentage under horticultural land condition might be due to higher accumulation of SOC.

Soil nutrient status under different land uses

Soil organic carbon

SOC was recorded highest in horticultural land (8.91 g kg of soil^{-1}) followed by cropland (5.96 g kg of soil^{-1}) and uncultivated land (3.65 g kg of soil^{-1}) in surface layer of soil (Table 2). Similar trend was observed in the 15-30 cm soil layer also. In case of surface soils all three land-uses were found significantly different whereas in sub-surface layer SOC content of cropland and uncultivated land were found at par. Notable reduction in SOC concentration in deeper layer as compared to upper layer in case of all the studied land-uses amounting 37.92, 35.47 and 7.95 per cent under cropland, horticultural land and uncultivated land respectively. Higher amount of carbon accumulation under horticultural land may be due to leaf litter fall in the surface and through root deposition in deeper layers (Zhou *et al.*, 2017). On the other hand, intensive cultivation, tillage and several management practices hastens the loss of SOC through facilitating microbial activities and the process of oxidation (Vikas Sharma *et al.*, 2014) while lower vegetative cover, erosion and overgrazing might be the reasons behind the poor carbon status in uncultivated lands (Adesodun *et al.*, 2005).

Available nitrogen, phosphorus and potassium

In surface soil, highest available N content was observed under horticultural land (100.35 kg ha^{-1}) followed by cropland (91.99 kg ha^{-1}) and uncultivated land (58.54 kg ha^{-1}). Depth-wise decrease in available N content was found in all three land-uses. In deeper layers also, horticultural land showed the maximum (80.49 kg ha^{-1}) and uncultivated land showed the least (52.27 kg ha^{-1}) values of available N (Table 2). Statistical similarity between horticultural land and cropland are marked characteristics of both the layers of soil. A similar trend of Horticultural land > cropland > uncultivated land was noted by Pal *et al.*, (2013). Higher organic input through leaf litter fall and root deposition in case of horticultural land might the cause that results in enhanced N mineralization. Cultivation facilitates oxidation rate of organic matter which in turn depletes the N availability in cropland (Emiru and Gebrekidan, 2013) as a positive correlation between SOM and available N was observed by many researchers.

Unlike available N, in surface soil, highest concentration of available P was recorded under cropland (25.61 kg ha^{-1}) followed by horticulture (25.03 kg ha^{-1}) and uncultivated land (13.03 kg ha^{-1}) whereas the soil layer of 15-30 cm depth followed a different trend of horticultural land (19.88 kg ha^{-1}) > cropland (18.19 kg ha^{-1}) > uncultivated land (10.03 kg ha^{-1}). Cropland and horticultural land were found statistically at par in both the layers while uncultivated land was significantly different from the two other land-uses in terms of available P (Table 2). Decrease in P content with depth was a common trait in all three land-uses. Better values of available P content in croplands may be due to long-term application of phosphatic fertilizers and addition of organic manures that increase P availability (Mohammadi *et al.*, 2009). Lower P content in uncultivated land may be attributed to higher accumulation of carbonates that facilitate P sorption and this effect is more pronounced in case of coarse textured soils as compared to fine textured soils (Vig *et al.*, 2000).

Table.1 Basic physico-chemical properties of soil under different land-uses at 0-15 and 15-30 cm depths

Basic parameters	**0-15 cm depth**			**15-30 cm depth**		
	Cropland	Horticulture	Uncultivated	Cropland	Horticulture	Uncultivated
pH	7.98 NS(±0.05)	7.68 NS (±0.02)	7.94 NS (±0.20)	7.91 NS (±0.03)	7.71 NS(±0.06)	7.94 NS(±0.18)
EC (dS m^{-1})	0.46NS (±0.02)	0.32NS (±0.04)	0.41NS (±0.08)	0.39 NS(±0.03)	0.35 NS(±0.02)	0.42 NS(±0.06)
Sand (%)	75.50b (±0.56)	70.17c (±1.51)	79.67a (±0.95)	74.17a (±0.48)	67.17b (±2.30)	78.00a (±1.29)
Silt (%)	15.67ab (±0.61)	19.00a (±1.65)	11.67b (±1.48)	14.67b (±1.17)	19.17a (±0.54)	13.33b (±1.58)
Clay (%)	8.83b (±0.17)	10.83a(±0.60)	8.67b (±0.8-)	11.17a (±1.49)	13.67a (±2.09)	8.67a (±0.61)
BD (Mg m^{-3})	1.53a (±0.01)	1.36b (±0.03)	1.42ab (±0.06)	1.65a (±0.03)	1.46b (±0.02)	1.54b (±0.05)
WSA (%)	58.05b (±1.14)	70.12a (±1.22)	52.67c (±0.45)	60.61b (±0.94)	72.11a (±0.85)	55.42c (±0.58)

Mean values are in rows, values in parenthesis indicate standard error of mean and dissimilar letters indicate significant differences at 5 % level of significance
NS= Not significant

Table.2 Soil organic carbon concentration (g kg^{-1} soil) and available N, P and K contents (kg ha^{-1}) under different land-uses at 0-15 and 15-30 cm soil depths

Land-use	**0-15 cm depth**				**15-30 cm depth**			
	SOC concentration (g kg soil^{-1})	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})	SOC concentration (g kg soil^{-1})	Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})
Cropland	5.96b (±0.16)	91.99a (±4.18)	25.61a (±0.90)	225.87a (±5.90)	3.70b (±0.34)	71.08a (±4.48)	18.19a (±0.20)	200.67a (±11.51)
Horticulture	8.91a (±0.32)	100.35a (±3.24)	25.03a (±0.88)	220.27a (±8.26)	5.75a (±0.55)	80.49a (±5.47)	19.88a (±1.36)	185.73a (±13.05)
Uncultivated	3.65c (±0.17)	58.54b (±5.53)	13.03b (±1.03)	126.00b (±9.99)	3.36b (±0.19)	52.27b (±3.50)	10.03b (±1.12)	91.47b (±5.35)
LSD (0.05)	0.696	13.314	2.836	24.785	1.166	13.730	3.091	31.669

Mean values are in columns, values in parenthesis indicate standard error of mean and dissimilar letters indicate significant differences at 5 % level of significance
NS= Not significant

Table.3 Available micronutrients (Fe, Mn, Zn aand Cu) (mg kg^{-1}) under different land-uses at 0-15 and 15-30 cm soil depths

Land-use	**0-15 cm depth**					**15-30 cm depth**			
	Available Fe (mg kg soil^{-1})	Available Mn (mg kg soil^{-1})	Available Zn (mg kg soil^{-1})	Available Cu (mg kg soil^{-1})		Available Fe (mg kg soil^{-1})	Available Mn (mg kg soil^{-1})	Available Zn (mg kg soil^{-1})	Available Cu (mg kg soil^{-1})
Cropland	10.75b (±2.02)	2.84b (±0.23)	0.54b (±0.12)	0.49b (±0.06)		8.60a (±1.84)	3.85a (±0.51)	0.35b (±0.03)	0.50b (±0.07)
Horticulture	15.43a (±1.35)	3.94a (±0.40)	4.07a (±0.93)	1.24a (±0.23)		12.38a (±2.34)	4.16a (±0.59)	1.99a (±0.23)	0.80a (±0.04)
Uncultivated	2.65c (±0.32)	1.37c (±0.13)	0.20b (±0.03)	0.18b (±0.02)		2.27b (±0.24)	1.18b (±0.08)	0.22b (±0.03)	0.16c (±0.02)
LSD (0.05)	4.263	0.839	1.628	0.415		5.196	1.369	0.409	0.145

Mean values are in columns, values in parenthesis indicate standard error of mean and dissimilar letters indicate significant differences at 5 % level of significance

NS= Not significant

Table.4 Correlations among selected soil physico-chemical properties and nutrients irrespective of soil depths

	pH	**EC**	**Sand**	**Silt**	**Clay**	**BD**	**WSA**	**SOC**	**Av N**	**Av P**	**Av K**	**Av Fe**	**Av Mn**	**Av Zn**	**Av Cu**
pH	1														
EC	0.748^{**}	1													
San	0.517^{**}	0.506^{**}	1												
Silt	-0.505^{**}	-0.594^{**}	-0.800^{**}	1											
Clay	-0.229	-0.100	-0.664^{**}	0.082	1										
BD	0.390^{*}	0.460^{**}	-0.078	-0.066	0.212	1									
WSA	-0.395^{*}	-0.401^{*}	-0.848^{**}	0.700**	0.535^{**}	0.145	1								
SOC	-0.333^{*}	-0.229	-0.525^{**}	0.541**	0.198	-0.096	0.681^{**}	1							
Av N	-0.390^{*}	-0.365^{*}	-0.584^{**}	0.577**	0.250	-0.008	0.605^{**}	0.767^{**}	1						
Av P	-0.338^{*}	-0.285	-0.602^{**}	0.571**	0.287	0.079	0.585^{**}	0.764^{**}	0.878^{**}	1					
Av K	-0.226	-0.261	-0.568^{**}	0.469**	0.359^{*}	0.215	0.588^{**}	0.661^{**}	0.805^{**}	0.916^{**}	1				
Av Fe	-0.111	-0.230	-0.437^{**}	0.537**	0.056	0.086	0.671^{**}	0.610^{**}	0.564^{**}	0.605^{**}	0.607^{**}	1			
Av Mn	-0.124	-0.105	-0.424^{*}	0.328	0.294	0.369^{*}	0.692^{**}	0.519^{**}	0.470^{**}	0.502^{**}	0.676^{**}	0.660^{**}	1		
Av Zn	-0.354^{*}	-0.435^{**}	-0.662^{**}	0.616**	0.331^{*}	-0.083	0.757^{**}	0.751^{**}	0.594^{**}	0.557^{**}	0.462^{**}	0.475^{**}	0.329^{*}	1	
Av Cu	-0.337^{*}	-0.414^{*}	-0.699^{**}	0.626**	0.380^{*}	0.092	0.798^{**}	0.726^{**}	0.711^{**}	0.664^{**}	0.615^{**}	0.560^{**}	0.467^{**}	0.937^{**}	1
****. Correlation is significant at the 0.01 level (2-tailed).**															
***. Correlation is significant at the 0.05 level (2-tailed).**															

Comparatively fine textured soil and higher OM addition cold be the reason behind moderately higher concentration of available P. The data in Table 2 depicts highest observed available K in cropland (225.87 kg ha^{-1}) followed by horticulture (220.27 kg ha^{-1}) and uncultivated land (126 kg ha^{-1}) in surface soil. A similar trend was also noted in 15-30 cm soil layer. At both 0-15 and 15-30 cm depths, horticultural land and crop land were found to be statistically at par with respect to available K. Decrease in available K content of about 11, 16 and 27 per cent under cropland, horticultural land and uncultivated land in 15-30 cm layer as compared to 0-15 cm layer was observed. Higher available K under cropland than other land-uses may be due application of potassic fertilizers (Landon *et al.,* 1991). Comparatively high amount of available K in case of horticulture than uncultivated land may be due to higher deposition of organic matter, release of bound K from decomposition of litter fall and solubilisation of insoluble forms of K. Lower available K in the uncultivated land may be probably due to soil degradation and losses by leaching (Moges *et al.,* 2013).

Available micronutrients

DTPA-extractable micronutrient (Fe, Mn, Zn and Cu) were significantly influenced by agricultural land-uses (Table 3). At surface soil layer, available Fe concentrations were about 30 and 83 per cent lower under cropland and uncultivated land respectively as compared to horticultural land. Similar trend of horticulture (12.38 mg kg^{-1}) > cropland (8.60 mg kg^{-1}) > uncultivated land (2.27 mg kg^{-1}) was noticed in 15-30 cm depth also. Concentration of available Fe decreased markedly with depth irrespective of land-uses. Like Fe, highest concentration of available Mn was recorded in horticultural land followed by cropland and uncultivated land both in 0-15 and 15-30 cm soil layers but an increase in Mn content with increase in depth was observed in case of cropland and uncultivated land. All three land-uses were significantly different with each other in terms of Fe and Mn availability in surface soil but in subsurface layer, horticultural land and cropland showed statistical similarity.

Irrespective of land-uses and depths, DTPA-extractable Zn content ranged from 0.20-4.07 mg kg^{-1}of which horticultural land was recorded with highest value (4.07 mg kg^{-1}) followed by cropland (0.54 mg kg^{-1}) and uncultivated land (0.20 mg kg^{-1})in surface soil and a same sequence was found in sub-soil also. On comparing Zn content, cropland and uncultivated land were observed statistically at par in both layers. The mean value of available Cu was recorded highest in horticulture and least in uncultivated land in both surface and sub-surface layer. Like Zn, in surface soil, statistical similarity was showed by cropland and uncultivated land in terms of DTPA-extractable Cu but in sub-surface layer significant difference was found among all the three land-uses.

Higher amount of micronutrients observed in horticulture and cropland as compared to uncultivated lands corroborates with the observation of some other researchers also (Dhaliwal *et al.*, 2008a, Dhaliwal and Bijay-Singh, 2013). Micronutrient rich soils of horticultural lands may be due addition of organic matter in the form of litter fall which also influences microbial activity that facilitates the availability of the elements (Reganold and Palmer, 1995, Sharma *et al.*, 1999). Somasundaram *et al.,* (2009) and Jiang *et al.,* (2009) have been reported that there is a positive and significant correlation between micronutrients with SOC and similar trend was observed in our study also. Regular application of fertilizers and farm yard manures in the croplands leads to addition of OC which facilitates the availability of micronutrients (Dhaliwal *et al.*, 2009; Rattan *et al.*, 1999). On the other hand, continuous crop removal, intensive cultivation and disturbances during different management practices are causes behind the lower content of micronutrients under cropland as compared to horticulture on an average. Low available micronutrient status in uncultivated lands may be due to erosional loss, poor texture and lower clay contents as Dhaliwal *et al.,* (2008b) and Rawat *et al.,* (1998) found positive correlation between micronutrient availability and clay content.

Correlation Matrix

To determine the extent of the relationships among different soil physico-chemical properties and nutrients correlation analysis was conducted. Significant correlations ($P \leq 0.01$ and $P \leq 0.05$) were observed among most of the macro and micro nutrients of soil irrespective of soil depths (Table 4)which is in conformity with the findings of Mahashabde and Patel (2012).Like the findings of many researchers a negative correlation between SOC content BD ($r = -0.096$) was also found in our study. WSA was found highly correlated with both SOC ($r = 0.681$, $p = 0.01$) and clay content ($r = 0.535$, $p = 0.01$).A significant positive correlation ($r = 0.767$, $p = 0.01$) between available N and SOC was recorded in our study which corroborates with the findings of other researchers also (Nweke and Nnabude, 2014; Kumar *et al.,* 2014). All the micronutrients exhibited significant correlation with SOC. Positive correlation between micro-nutrients and clay content was also noted which were more pronounced in case of zinc ($r = 0.331$, $p = 0.05$) and copper ($r = 0.380$, $p = 0.05$).

Results of the present study suggest that soils of the study area could be characterized as non-saline and slightly alkaline in reaction. Soil pH and EC of the study area were not found significantly affected by the land-uses. Textural class of cropland and horticultural land were sandy loam whereas in case of uncultivated land it was marked as loamy sand. A trend of horticultural land < uncultivated land < cropland was observed regarding BD which might be attributed to compaction of soil in case of cropland due to use of heavy machinery. Negative correlation ($r = -0.096$) between SOC and BD might be another reason behind it as SOC content followed the order horticultural land > cropland > uncultivated land. Horticultural land showed highest WSA percentage (70.12 %) followed by cropland (58.05 %) and uncultivated land (52.67 %) in surface layer and the trend was found similar in sub-surface soil also. This might be due to significant positive correlation of WSA with both SOC ($r = 0.681$, $p = 0.01$) and clay content ($r = 0.535$, $p = 0.01$). Significant effect of all the land-uses on SOC were observed in surface soil while cropland and uncultivated land were found at par in sub-soils. Available N content was found deficient in the study area irrespective of land-uses and depths. Highest N content was recorded in horticultural land followed by cropland and uncultivated land whereas a different trend of cropland > horticultural land > uncultivated land was noted in case of available K. These trends were noted both in 0-15 and 15-30 cm soil depths. Like available K, cropland exhibited highest available P and uncultivated land showed lowest concentration in surface layer but a different scenario was observed in deeper layer i.e. horticultural land > cropland > uncultivated land. statistical similarity among cropland and horticulture were noted with respect to N, P and K contents irrespective of soil depths. Availability of all four micronutrients were recorded highest under horticultural land and least in uncultivated land while no particular trend was observed along the profile. Significant positive correlation were noted among almost all the soil macro and micronutrients irrespective of depths. Therefore, we can conclude that land-uses hold a vital role in influencing the soil quality by altering its physico-chemical properties and both the macro and micro nutrient status. So, proper selection of suitable land-uses is of utmost importance to mitigate the degradation of soil quality along with the fulfilment of human needs through improved production strategies.

References

Adesodun, J. K., Adeyemi, E. F. and Oyegoke, C. O., 2007. Distribution of nutrient elements within water stable aggregates of two tropical agro-ecological soils under different land-uses. *Soil and Tillage Research*92: 190-197.

Adesodun, J. K., Mbagwu, J. S. C. and Oti, M. 2005. Distribution of carbon, nitrogen and phosphorus in water-stable aggregates of an organic waste amended ultisol in southern Nigeria. *Bioresource Technology*96: 509-516.

Bot, A. and Benites, J., 2005. The importance of Soil Organic Matter: Key to drought-resistant soil and sustained food and production. Rome, Italy: Food and Agriculture Organization of the United Nation.

Chaudhari, R., Ahire, V., Vidya, D., Chakravarty, M. and Maity, S., 2013. Soil bulk density ass related to soil texture, organic matter content and available total nutrients of Coimbatore soil. *International Journal of Scientific and Research Publications* 3: 123-131.

Cotrufo, F., Conant, R. and Paustian, K., 2011. Soil organic matter dynamics: land use, management and global change. *Plant and Soil* 338: 1-3.

Dhaliwal, S. S. and Bijay-Singh, 2013. Depth wise distribution of macronutrients, micronutrients and microbial populations under different land use systems. *Asian Journal of Soil Science*8:404- 411.

Dhaliwal, S. S., Bijay-Singh and Sharma, B. D., 2008b. Soil quality and sustainability indices as influenced by potassium distribution in submontaneous tract of Punjab. *Indian Journal of Dryland Agricultural Research Development*23: 42-47.

Dhaliwal, S. S., Bijay-Singh, Sharma, B. D. and Khera, K. L., 2009. Soil quality and yield trends of different crops in low productive submontaneous tract and highly productive area in Punjab, India. *Indian Journal of Dryland Agricultural Research and Develop*24: 39-45.

Dhaliwal, S. S., Sharma, B. D., Bijay-Singh and Khera, K. L., 2008a. Profile distribution of chemical, physical and microbial characteristics in four land use systems of Sadh Di Khadwatershed in submontaneous tract of Punjab. *Asian Journal of Soil Science*3: 316-322.

Emiru, N. and Gebrekidan, H., 2013. Effect of land use changes and soil depth on soil organic matter, total nitrogen and available phosphorus contents of soils in Senbat Watershed, Western Ethiopia. *Journal of Agricultural and Biological Sciences*8:206-212.

Gee, G. W. and Bauder, J. W., 1986. Particle size analysis In: *Methods of soil analysis*. Part I. A klute (ed) Agronomy No. 9 Am Soc Agron Madison, USA Pp. 383-411.

Genxu, W., Haiyan, M., Ju, Q. and Juan, C., 2004. Impact of land use changes on soil carbon, nitrogen and phosphorus and water pollution in an arid region of northwest China. *Soil Use and Management* 20(1): 32-39.

Gupta-Choudhuri, S., Bandyopadhyay, P. K. and Mallick, S., 2008 Distribution of Particulate Organic Carbon within Water Stable Aggregates of Inceptisol Profiles under different Land Use. *Journal of Soil and Water*

*Conservation*7:24-30.

Holeplass, H., Singh, B. R. and Lal, R. 2004. Carbon sequestration in soil aggregates under different crop rotation and nitrogen fertilization in an Inceptisol in southern Norway. *Nutrient Cycling in Agroecosystem*70: 167-177.

Jackson, M. L., 1967.*Soil chemical analysis*. Practice Hall of India Pvt Ltd, New Delhi. Pp. 452- 485.

Jiang, Y., Zhang, G., Zhou, D., Qin Y. and Liang. W.J. 2002. Profile Distribution of Micronutrients in an Aquic Brown Soil as Affected by Land Use. *Plant, Soil and Environment* 155(11): 468 – 476.

Jiang, Y., Zhang, Y. G., Zhou, D., Qin, Y. and Liang, W. J. 2009. Profile distribution of micronutrients in an aquic brown soil as affected by land use. *Plant Soil and Environment*55:468–476.

Jiao, Y., Xu, Z. and Zhao, J. 2009. Effect of uncultivated conversion to cropland and forest on soil organic carbon and dissolved organic carbon in the farming-pastoral ecotone of Inner Mongolia. *Acta Ecologica Sinica*29: 150-154.

Karlen, D. L., Andrews, S. S., Wienhold, B. J., Zobeck, T. M., 2008. Soil Quality Assessment: Past, Present and Future. *Journal of Integrative Biosciences* 6: 3-14.

Karlen, D. L., Ditzler, C.A. and Andrews, A.S. 2003. Soil Quality: Why and How? *Geoderma* 114: 145–156.

Kumar Awinash, Mishra, V. N., Srivastav, K. and Banwasi Rakesh, 2014. Evaluation of fertility status of available major nutrients (N, P & K) and micro nutrients (Fe, Mn, Cu & Zn) in Vertisol of Kabeerdham district of Chhattisgarh, India. *International Journal of Interdisciplinary and Multidisciplinary Studies* 10: 72-79.

Landon, J. R. 1991. Booker Tropical Manual: A Handbook for Soil Survey and Agricultural Land Evaluation in the Tropics and Subtropics, Longman Scientific and Technical, New York, NY, USA.

Lemenih, M., Karltun, E. and Olsson, M. 2005. Assessing soil chemical and physical property responses to deforestation and subsequent cultivation in small holders farming system in Ethiopia. *Agriculture, Ecosystem and Environment* 105(1-2): 373–386.

Lindsay, W. H. and Norvell, W. A. 1978. Development of DTPA soil test for zinc, iron, manganese and copper. *Soil Science Society of America Journal*42: 421-428.

Mahashabde, J. P. and Patel, S., 2012. DTPA – extractable micronutrients and fertility status of soil in Shirpur Tahasil Region. International Journal of ChemTech Research 4:1681–1685.

Merwine, H. D. and Peech, M. 1951 Exchangability of soil potassium in the sand, silt and clay fractioned as influenced by the nature of the complementary exchangeable cation. *Soil Science Society of America, Proceedings*15: 125-128.

Moges, A., Dagnachew, M. and Yimer, F. 2013. Land Use Effects on Soil Quality Indicators: A Case Study of Abo-Wonsho Southern Ethiopia. *Applied and Environmental Soil Science* doi: 10.1155/2013/784989.

Mohammadi, S., Kalbasi, M. and Shariatmadri, H., 2009. Cumulative and residual effects of organic fertilizer application on selected soil properties, water soluble P, Olsen P and phosphorus sorption index. *Journal of Agricultural Science and Technology*11: 487-497.

Mrabet, R., Saber, N., El-Brahil, A., Lahlou, S. and Bessam, F. 2001. Tolal, particulate organic matter and structural stability of a Calcixeroll soil under different wheat rotations and tillage systems in a semi area of Morocco. *Soil and Tillage Research*57: 225-235.

Murty, D., Kirschbaum, M. U. F., Mcmurtrie, R. E. and Mcgilvray, H., 2002. Does Conversion of Forest to Agricultural Land Change Soil Carbon and Nitrogen? A Review of the Literature. *Global Change Biology* 8 (2):105-123.

Nweke, I. A. and Nnabude, P. C., 2014. Organic Carbon, total nitrogen and available phosphorous concentration in aggregate fractions of four soils under two land use systems. International Journal of Research in Applied, Natural and Social Sciences 2:273–288.

Olsen, S. R., Cole, C. V., Watanabe, F. S. and Dean, L. A. 1954. Estimation of available phosphorus by extraction with sodium bicarbonate. *United States. Department of Agriculture, Circular* Pp. 939.

Onwudike, S. U., Ihem, E.E., Irokwe, I.F. and Onwuso,, G., 2015 Variability in the Physico-chemical Properties of Soils of Similar Lithology in Three Land Use Types in Ahiazu Mbaise, Imo State Nigeria. *Journal of Agriculture and Crops* 1(3): 38-43.

Pal, S., Panwar, P. and Bhardwaj, D. R., 2013. Soil quality under forest compared to other land- uses in acid soil of north western Himalaya, India. *Annals of Forest Research*56: 187-198.

Paz-Kagan, T., Shachak, M., Zaady, E. and Karnieli, A., 2014. A spectral soil quality index (SSQI) for characterizing soil function in areas of changed land use. *Geodarma* 230-231: 171-184. doi:10.1016/j.geoderma.2014.04.003.

Rattan, R. K., Neelam, S. and Datta, S. P., 1999. Micronutrient depletion in Indian Soils: Extent causes and remedies. *Fertilizer News* 44: 35-40.

Rawat, M. S., Tripathi, R. P. and Nand, R., 1998. Long term effect of puddling, fertilizer and manures on transmission characteristics of a Hapludoll under rice-wheat-cowpeas system. *Journal of Indian Society of Soil Science*46: 128-129.

Reganold, J. P. and Palmer, A. S., 1995. Significance of gravimetric versus volumetric measurements of soil quality under biodynamic, conventional and continuous grass management. *Journal of Soil and Water Conservation*50: 298-305.

Reganold, J. P., 1995. Soil quality and profitability of biodynamic and conventional farming systems: A review. Organic Farming & Biodynamic Agriculture Training resource book. 10, 64-75.

Richard, L. A., 1954. *Diagnosis and improvement of saline and alkaline soils.* Pp 7-33.

Sakin, E., 2012. Bulk density of Harran plain soils in relation to other soil properties. African Journal of Agricultural Research. 6(7): 1750- 1757.

Sarawathy, R.., Suganya, S. and Singaram, P., 2007. Environmental Impact of Nitrogen Fertilization in Tea Eco-system. *Journal of Environmental Biology* 28:779 -788.

Seto, K. C., Woodcock, C. E., Song, C., Huang, X., Lu, J. and Kaufmann, R. K., 2002. Monitoring Land Use Change in the Pearl River Delta Using Landsat TM. *International Journal of Remote Sensing* 23: 1985-2004. doi: 10.1080/01431160110075532

Sharma, B. D., Jassal, H. S., Sawhney, J. S. and Sidhu, P. S., 1999. Micronutrient distribution in different physiographic units of the Siwalik Hills of the semi-arid tract of Punjab, India. *Arid Soil Research and Rehabilitation*13: 1-12.

Sintayehu, M., 2006. Land Use Dynamics and its Impact on Selected Physicochemical

Properties of Soils in YabelloWoreda of Borana Lowlands, Southern Ethiopia [M.S. thesis], Haromaya University, Haromaya, Ethiopia.

Smith, C. J. and Goh, G., 1995. Effects of organic and inorganic calcium compounds on soil solution pH and Al concentration. *European Journal of Soil Science* 46: 53-63.

Somasundaram, J., Singh, R. K., Parandiyal, A. K. and Prasad, S. N., 2009. Micronutrient Status ofSoils under Different Land Use Systems in Chambal Ravines. *Journal of Indian Society of Soil Science*57: 307-312.

Subbiah, B. V. and Asija, G. L., 1956. A rapid procedure for the estimation of available nitrogen in soils. *Current Science*25: 259-260.

Tisdale, S. L., Nelson, W. L. and Beaton, J. D. 1993. Soil fertility and fertilizers, 5thed Macmillan publishing Co. Inc.NewYark and Colloir Macmillan publishers London.

Vig, A. C., Yashpal, Saroa, G. S. and Bahl, G. S., 2000. Forms of P and efficacy of different soil tests for P extractability in calcareous soils. *Journal of Indian Society of Soil Science* 48: 527-532.

Vikas-Sharma, Shabeer Hussain, Sharma, K. R. and Arya, V. K., 2014. Labile carbon pools and soil organic carbon stocks in foothill Himalayas under different land use systems. *Geoderma*232-234:81-87.

Walkley, A. and Black, C. A., 1934. An examination of the Degtjareft method for determining soil organic matter and a proposed modification of the chromic acid titration method. *Soil Science*37: 29-38.

Wasihun, M., Muktar, M. and Teshome, Y., 2015. Evaluation of Effect of land use types on Selected Soil Physicochemical Properties in Itang-Kir area of Gambella region, Ethiopia. *Journal of Biology, Agriculture and Healthcare* 5(13): 128-138.

Yifru, A. and Belachew, T., 2011. Effects of land use on soil organic carbon and nitrogen in soils of bale, south-eastern Ethiopia. *Tropical and Subtropical Agroecosystems* 14: 225-235.

Yoder, R. E., 1936. A Direct Method of Aggregate Analysis of Soil and a Study of the Physical Nature of Erosion Losses. *Jooournal of American Society Agronomy* 28: 337-351.

Zhou, Z. and Wang, C., 2017. Soil-microbe-mineralization carbon and nitrogen stoichiometry under different land-uses in the Maoershan region. *Acta Ecologica Sinica* 37: 1-9.

How to cite this article:

Agniva Mandal, A. S. Toor and Dhaliwal S. S. 2018. Effect of Land-uses on Physico-Chemical Properties and Nutrient Status of Surface (0-15 cm) and Sub-Surface (15-30 cm) Layers in Soils of South-Western Punjab, India. *Int.J.Curr.Microbiol.App.Sci.* 7(06): 2659-2671.
doi: https://doi.org/10.20546/ijcmas.2018.706.315