International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(3): 2522-2527

Received: 22-03-2018
Accepted: 23-04-2018

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Effect of cultivation on available nutrients and organic carbon content in soil under different land use systems of Haryana

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Abstract
This study was conducted by collecting the surface soil samples from prominent land use systems of Haryana state locating in different agro eco -systems having different soil types. Three land use systems viz; agriculture, horticulture and vegetable were selected and within agriculture land use system, the samples were collected from rice -wheat, cotton- wheat, pearl millet- wheat and sugarcane –sugarcane cropping system. In horticulture land use system, two orchards of guava and citrus from University horticulture farm were selected. In vegetable land use system the samples were collected from university research farm which were under cultivation of tomato/potato/cauliflower/brinjal from a long time. The results revealed that the organic carbon content of soil was higher under cultivated soil than uncultivated soil conditions. The organic carbon content and available P, K, S was found higher under horticulture land use system as compared to agriculture and vegetable land use system while available N and micronutrients was found higher under agriculture land use system. The available nitrogen, phosphorus and sulphure was found higher under cultivated condition while available potassium was found higher under uncultivated conditions. Zinc, iron and copper micronutrients content was found higher under cultivated soils than uncultivated soils while Mn content was noticed higher under uncultivated soils. Available nutrient status of cultivated soils was observed higher where higher amount of fertilizers and manures are in practices and cultivation of crops increased the organic carbon content of soil and found highly correlated with the availability of nutrients in soil.

Keywords: Land use system, cultivation, organic carbon, available nutrients

1. Introduction

Haryana is a state which has played a very important role during green revolution in the country "India" and in making self sustained food production. During green revolution time, major factors which brought such difference in yield, was bringing of uncultivated area under cultivation by making use of irrigation water by constructing canals and channels. Various land use systems are followed in the state, these have different effects in the soil nutrient status and organic carbon content. India being a tropical country have a very low organic carbon content which make conditions more miserable in respect of over cultivation. Soil organic carbon (SOC) is a key component of the soil-plant ecosystem and is closely associated with soil properties and processes, nutrient buffering and supply, as well as emission and storage of greenhouse gases [1-3]. Besides being a source and sink of nutrients for plants, the SOC has an important function in the carbon (C) cycle, accounting for the major terrestrial pool of the various elements [4]. Many studies have suggested that land use change is the main factor determining SOC content because of its effects on soil aggregates [2], microbial activity, and biogeochemical cycles [5] These biogeochemical changes are directly linked to the future productivity and stability of SOC [6] Soil fertility and productivity of any land area depends on the SOM and nutrient content of soil and also on the land use and management practices. Thus to understand the sustainable use potential of the land and associated effects, it is necessary to know the effect of land use on soil properties associated with soil fertility and productivity. In Haryana such study has not conducted earlier, so the purposes of this study are to:

1) Evaluate the effects of land use change on SOC and soil available nutrient status on different land use types;
2) Analyze the relationship between SOC and soil available nutrient status.

2. Materials and Methods
2.1 Study site
The experiment was conducted in the CCS Haryana Agricultural University hisar, Haryana. The soil samples were collected from different locations having different soil types and environmental conditions. Three land use systems were selected, agriculture, Horticulture, vegetable. Within agriculture land use system samples were collected from four different cropping systems. In horticulture land use system two orchards were considered guava and citrus. In vegetable land use system the samples were collected from fields of tomato/potato/cauliflower/brinjal. All these systems were located in different agro ecological zones, with different atmospheric conditions.

Details of the experimentation site:

LUS	Geographical Location	Soil texture	Annual mean temp. (^{0}C)	Annual rainfall (mm)
Agriculture 1. Cotton-wheat	CRS Sirsa Latitude:29° 53' N Longitude: 75° 01' E	Loamy-sand	5.1-46.7	375
2. Rice-wheat	RRS Kaul Latitude: 29° 42' N Longitude: 77° 02' E	Loam	5.9-40.2	700
3. Pearlmillet-wheat	Research Farm, Dept. Of Soil Science Latitude: 29° 10' N Longitude:75° 46' E	Sandy-loam	1.9-46	450
4. Sugarcane	RRS Uchani Latitude: 28° 16' N Longitude: 77° 05' E	Clay-loamy	6-39	766
Horticulture 1. Citrus	Research Farm, Dept. Of Horticulture Latitude: 29° 10' N Longitude: 75° 46' E	Sandy-loam	1.9-46	450
2. Guava	Research Farm, Dept. Of Horticulture Latitude: 29° 10' N Longitude: 75° 46' E	Sandy-loam	1.9-46	450
Vegetable 1.Tomato/potato/ cauliflower/brinjal	Research Farm, Dept. Of Vegetable Science Latitude: 29° 10' N Longitude: 75° 46	Sandy-loam	1.9-46	450

2.2 Soil sampling
Surface (0-15) soil samples from each land use system were collected from five different locations by an auger from each selected site in June, 2015. Soil samples were collected after removing the litter layer then air dried, grounded and sieved (2mm) for carrying out the chemical analysis.

2.3 Sample analysis for various parameters
2.3.1 Available nutrients content and other parameters:

Parameter	Method	Reference
pH (1:2::Soil:water suspension)	Potentiometric method	[7]
EC (1:2::Soil:water suspension)	Conductometric method	[7]
Organic Carbon	Wet oxidation method	[8]
Available N	Kjeldahl-distillation	[9]
Available P	$NaHCO_3$ extraction method	[10]
Available K	Flame photometry	[7]
Available S	Spectrophotometry	[11]
DTPA extractable Micronutrients	Atomic Absorption Spectrophotometer	[12]
Cation exchange capacity	Flame photometry	[13]

2.4 Data Analysis
All results are reported as mean ± standard error. Data were analyzed by one-way ANOVA with land use type as the factor. Least significant difference ($p<0.05$) was used to separate the means when differences were significant. Pearson′s test was used to determine whether significant correlations existed between measured soil properties and MBC. Statistical analysis was performed by using [14]

3. Results
3.1 Soil organic carbon
Total organic carbon in different land use systems varied from 3.50 to 9.72 g kg $^{-1}$. Soil organic carbon was found highest under horticulture land use system, within which higher content was obtained under guava orchard as compared to citrus orchard. As compared to uncultivated soil i.e soil of the foot path near field, cultivated soil was noticed with higher content of total organic carbon. The SOC was found (7.29g kg^{-1}) significantly higher under cultivated soil than in uncultivated soil (5.22 g kg^{-1}). Among agriculture land use system highest mean soil organic carbon was found in sugarcane-sugarcane (8.32 g kg^{-1}).

3.2 Soil physic-chemical properties
Soil under different land use systems do not vary significantly in terms of soil pH and EC. The lowest pH of 7.72 was observed under cultivated conditions of rice-wheat cropping system, while under same conditions, the highest pH of 7.99 was observed under pearl millet-wheat condition. Overall cultivated soil found to have lower pH than uncultivated soil with mean value of 7.81 and 7.96 respectively. The amount of EC was found highest in cotton–wheat system followed by guava orchard and citrus orchard with mean values of 0.61, 0.50, 0.44 dSm^{-1} respectively. EC of cultivated soil was lower than uncultivated soils except citrus and vegetable land use system and lowest EC of 0.22 dSm^{-1} was observed in rice-wheat cropping system under cultivated conditions.

The mean value of CEC was found to varied from 9.64 cmol (p^+) kg^{-1} (pearl millet-wheat) to 20.78 cmol (p^+) kg^{-1}(rice-wheat) under cultivated conditions. The CEC of soil is higher under rice-wheat (20.78 cmol (p^+) kg^{-1}) cropping system followed by sugarcane-sugarcane cropping system (19.62 cmol (p^+) kg^{-1}). Among horticulture land use system higher CEC was observed under citrus orchard (11.66 cmol (p^+) kg^{-1}) followed by guava orchard (11.42 cmol (p^+) kg^{-1}). Significantly higher CEC was observed under cultivated conditions (13.04 cmol (p^+) kg^{-1}) as compared to uncultivated (11.81cmol (p^+) kg^{-1}) soil conditions.

3.4 Available nutrients
3.4.1 Available nitrogen
The available nitrogen in soil varied from 123.1 to 156.8 kg ha^{-1} under cultivated conditions of different land use system and highest amount was observed under sugarcane-sugarcane land use system. Available nitrogen in uncultivated soil conditions varied from 80.8 to 121.2 kg ha^{-1} under different land use systems and was found significantly higher in cultivated soil than uncultivated conditions with mean value of 136.5 and 107.5 kg ha^{-1} respectively.

3.4.2 Available phosphorus
The amount of available phosphorus was observed higher in horticulture land use system than agriculture land use system and highest amount of available phosphorus (112.5 kg ha^{-1}) was observed in citrus orchard while lowest amount of available phosphorus was observed in sugarcane-sugarcane cropping system. Cultivated soil was found having higher quantity of available phosphorus than uncultivated soil in every land use system with a mean value 60.9 and 33.7 kg ha^{-1} respectively.

3.4.3 Available Sulphur
Available sulphur content varies in the same manner as carbon content and horticulture land use system was recorded with highest (155.47kg/ha citrus) content of sulphur followed by sugarcane-sugarcane land use system (100.04kg/ha). Overall, the availability of sulphur is higher in cultivated conditions as compared to path soil/ uncultivated soil near to the field with mean value in all the land use system is 125.45 kg/ ha.

3.4.4 Available potassium
The available potassium in cultivated soil varied from 229.5 to 651.4 kg ha^{-1} under different land use system. The amount of available potassium was observed higher under horticulture land use system than agriculture land use system and highest amount was observed under guava orchard. In contrast to N and P the available potassium was found higher under uncultivated soil than cultivated soil and its status varied from 234.3 to 1395.2 kg ha^{-1} under different soil conditions.

3.4.5 Available micronutrients
DTPA extractable micronutrients cations as Fe, Cu, Mn are higher under agriculture land use system than horticulture land use system while Zn reported reverse in order. Among these micronutrients, iron content was noted highest in rice-wheat cropping system, followed by sugarcane-sugarcane (19.32 mg kg^{-1}) Available iron content was observed higher (11.09 mg kg^{-1}) under cultivated condition than uncultivated soil (8.17 mg kg^{-1}) and lowest amount of iron was reported under uncultivated vegetable LUS (2.16 mg kg^{-1}) as compared to other land use system. Sugarcane- sugarcane land use system observed with highest (4.22ppm) zinc content followed by vegetable land use system with mean value 3.42 ppm. The available copper varied from 1.21 to 2.50 mg kg^{-1} and highest amount of available copper was observed under rice-wheat (2.50 ppm) cultivated cropping system. On comparing cultivated with uncultivated soil, higher content of copper was observed under former than latter with mean value of 1.65 and 1.27 mg kg^{-1} respectively. The content of available manganese was in soil found to vary from 4.71 mg kg^{-1} (cotton-wheat) to 9.43 mg kg^{-1} (pearl millet-wheat). Effect of cultivation on available Mn was non consistent and higher amount of available Mn was observed in uncultivated soil of cotton-wheat, rice-wheat, sugarcane-sugarcane and pearl millet-wheat cropping system as compared to their cultivated conditions (7.73 ppm).

4. Discussion
4.1 Soil physic-chemical properties
The pH of soil found to vary under different land use system. Highest pH was found under cotton-wheat land use system followed by vegetable land use system. pH is affected by organic carbon content. Lowest pH was observed under horticulture land use system than agriculture land use system because of higher content of organic carbon in the former. The pH of cultivated soils found to have significantly lower pH as compare to uncultivated soils. This may be attributed to higher addition of organic matter whose decomposition leads to release of organic acids which reduces the pH of the cultivated soil and more depletion of basic cations due to crop removal. These results are in accordance the findings of [15] who reported decrease in pH with the addition of organic residue and manure due to production of organic acid in fertilized plot over control.

Cultivated soils found to have lower EC than uncultivated soils which may be attributed to frequent irrigation application in cultivated soils which flushes out the dissolved salts deeper in soil. This result is consistent with [16] who concluded higher EC in irrigated field than rainfed cropping system and reported higher EC under agri-horticulture system as compared to perennial vegetation.

Soil texture of different land use system found to vary from clay loam under sugarcane-sugarcane land use system to sandy loam under pearl millet-wheat, horticulture and vegetable land use system. On comparing LUS system within almost similar textural class higher value of CEC was observed in citrus orchard followed by guava and vegetable land use system while lower values are found under pearl miller-wheat cropping system. This may be due to higher organic carbon in the horticultural land use system than agriculture land use system and CEC was found to highly positively correlated to organic matter content which increases the surface area of soil and increases its exchange capacity. These results are confirmatory with results of [16, 17] who reported higher CEC in cultivated soils under perennial crops, agri-horticulture system than ravines land.

4.2 Soil organic carbon
Soil C and its pool in an ecosystem is controlled by the balance between the C inputs derived from litter fall, root biomass and root exudates and the outputs through heterotrophic respiration. Soil organic carbon concentration and stocks were significantly higher under horticulture land use system. This is due to the continues litter fall from the trees, which keep on building the organic matter to soil and regarded as the chief source of organic carbon. Higher amount

of organic carbon was found in the horticulture followed by vegetable and agriculture land use system. This may be because of continuous addition of organic waste through litter fall and FYM addition in the soil [18]. reported that the increased soil temperature due to the less shading, low vegetation cover and tillage practices subsequently made the soils susceptible to erosion and thereby reduction in SOC. On comparing land use system under different agro-climatic conditions, higher content of SOC was found under rice-wheat and sugarcane-sugarcane cropping system than pearl millet-wheat and cotton-wheat cropping system. This may be due to lower annual temperature which decreases the rate of decomposition of organic matter hence favours accumulation of soil organic carbon as under rice-wheat and sugarcane-sugarcane cropping system.

Also, soil organic carbon decreases under uncultivated condition as compared to cultivated soils due to lower addition of plant residue. An increase in SOC levels is directly linked to the amount and quantity of organic residues return to the soils [19]. Besides addition of higher organic matter, their quality and rate of decomposition [20] might also have affected the carbon content in the soil. Similarly, [21] reported that cultivation of lands resulted in deterioration of soil properties compared to soils under well stocked natural forest, organic carbon declined in scrubland and agriculture land with respect to forest.

4.3 Available nutrients

The available macro nutrients were found higher under horticulture land use system than agriculture land use system except available nitrogen content. Available nitrogen content was found higher under agriculture land use system within which, highest content was recorded under rice-rice cropping system which is may be due more reduced conditions which hinders the conversion of ammonium nitrogen to nitrate i.e nitrification and hence, leaching losses of nitrogen are reduced. The available nitrogen content was found higher under rice-wheat and sugarcane-sugarcane cropping system as compared to cotton-wheat and pearl millet cropping system cropping system. This difference in contents is due to different agro-climatic regions which influences the decomposition process of organic matter and hence availability of nitrogen. The another possible reason may be due to prevalent lower temperature in the sugarcane growing locations and clay loam texture of the soil of that region which reduces the losses of nitrogen due to leaching and denitrification process.

On comparing within agro-climatic regions higher amount was observed under pearl millet-wheat than cotton-wheat cropping system and sugarcane-sugarcane cropping system was recorded with significantly higher available nitrogen content than rice-wheat due to higher addition of fertilizers and manures.

Phosphorus, potassium and sulphur content were more in horticulture land use system because of addition of these nutrients through fertilizers in bulk. A positive and linear relationship observed between carbon with sulphur and nitrogen which ascertains increase in these nutrients with increase in total organic carbon content.

Cultivated soils found to have higher content of available phosphorus (43.46%) compared to uncultivated soils because of addition of fertilizers and manures which along with replenishment of nutrients also reduces the losses due to erosion and fixation [22]. also observed higher available phosphorus under kitchen garden soil as compared to barren land. These findings are in agreement with the results of [23, 24].

The available potassium was found higher under horticulture land use system than agriculture land use system and higher amount of available K was observed under guava orchard followed by vegetable cropping system. This is due to higher and frequent application of potassic fertilizers under horticulture land use system as compared to agriculture land use system and due to continuous litter fall which replenish the pool of available K. These results are in agreement with the findings of [25, 26] who reported higher available K in citrus orchard as compared to maize cultivated soil.

The cultivated soils was recorded with lower content (34.66%) of available K as compare to uncultivated soils, possibly due to higher mining of potassium in cultivated soils and no addition of potash fertilizers. These results are in agreement with findings of [22] who reported higher amount of available K in barren land in comparison to cultivated conditions of maize. In contrast to above findings [23] reported higher K content under agriculture cultivated land than wasteland.

Horticulture land use system was found to have higher content of available sulphur as compare to agriculture land use system. Cotton-wheat and pear millet-wheat cropping system adopted in light texture soils have lower content of available sulphur as compare to rice-wheat and sugarcane-sugarcane cropping system adopted in heavy texture soils. Similarly higher content of available sulphur was found under guava than other horticulture land use system. Cotton-wheat was found to have higher content of sulphur than pearl millet-wheat. The possible reasons of these results are highly positive correlation of sulphur with soil organic carbon content, thereby, soils rich in SOC have higher content of available sulphur. Higher amount of available sulphur was observed under cultivated (150.15%) conditions than uncultivated soils. These results are in agreement with [27, 17]

The amounts of micronutrients were higher in agriculture land use system apart from available zinc content. The available iron was higher rice- rice cropping system due to continuous reduced conditions which enhances the availability of iron in the field due to release of iron from minerals. These results support the findings of [28, 25] while contradicting the results of [29]. The higher amount of copper under rice-wheat and sugarcane-sugarcane land use system compare to cotton-wheat and pearl millet-wheat cropping system. This may be due to additions of Cu through filler materials in the fertilizers and lower uptake of Cu in cotton-wheat and pearl millet-wheat cropping system than rice-wheat and sugarcane-sugarcane cropping system. The content of available micronutrients except Mn was found higher in cultivated soil than uncultivated soils. Higher content of manganese was found in the soil where higher amount of soil organic soil present. The manganese content was found higher in sugarcane-sugarcane cropping system than rice-wheat cropping system due to higher amount of organic carbon in former and also due to prevalent reduced conditions in rice cultivation which favours release of water soluble Mn, which is subjected to leaching losses. These findings are in accordance to results of [22]

5. Conclusion

Organic carbon content in soil was found higher under horticulture land use system as compared to other land use system. The cultivation of crops did not reduce the organic carbon content of soil rather it increases it and found highly correlated with the availability of nutrients in soil. The available phosphorus, potassium and sulphur was observed higher under horticulture land use system however available nitrogen was found higher under agriculture system. The available nitrogen, phosphorus and sulphure was found higher under cultivated condition while available potassium was found higher under uncultivated conditions. Zinc, iron and copper micronutrients content was found higher under cultivated soils than uncultivated soils while Mn content was noticed higher under uncultivated soils. Available nutrient status of cultivated soils was observed higher where higher amount of fertilizers and manures are in practices.

5.1 Correlation of nutrients and soil organic carbon

	SOC	**N**	**P**	**K**	**S**	**Zn**	**Fe**	**Mn**	**Cu**	**pH**
N	0.59**									
P	0.44^{NS}	0.07^{NS}								
K	0.05^{NS}	-0.61**	0.18^{NS}							
S	0.88**	0.63**	0.54*	-0.01^{NS}						
Zn	0.17^{NS}	0.01^{NS}	0.39^{NS}	0.01^{NS}	0.29^{NS}					
Fe	0.01^{NS}	0.41^{NS}	-0.11^{NS}	-0.50*	-0.09^{NS}	-0.17^{NS}				
Mn	-0.15^{NS}	0.23^{NS}	-0.28^{NS}	-0.26^{NS}	-0.11^{NS}	-0.49*	0.22^{NS}			
Cu	0.17^{NS}	0.37^{NS}	-0.13^{NS}	-0.41^{NS}	0.02^{NS}	-0.04^{NS}	0.75**	-0.02^{NS}		
pH	-0.57*	-0.77**	-0.21^{NS}	0.37^{NS}	-0.58*	-0.09^{NS}	-0.67**	-0.05^{NS}	-0.66**	
EC	-0.14^{NS}	-0.56*	0.45^{NS}	0.54*	0.02^{NS}	0.28^{NS}	-0.59**	-0.22^{NS}	-0.51*	0.47^{NS}

Table 1: Available primary nurtrients and organic carbon content

Land use system (LUS)	**Soil organic carbon (g kg $^{-1}$)**		**Available Nitrogen (kg ha^{-1})**		**Available Phosphorus (kg ha^{-1})**		**Available Potassium (kg ha^{-1})**		**Available Sulphur (kg ha^{-1})**	
	***[1]C.S**	***[2]Un.S**	**C.S**	**Un.S**	**C.S**	**Un.S**	**C.S**	**Un.S**	**C.S**	**Un.S**
Agriculture										
Cotton-Wheat	5.88±0.14	4.26±0.10	123.1±1.02	80.9±0.65	28.7±0.54	17.5±1.01	307.5±2.10	654.4±3.36	81.3±1.92	40.3±0.12
Rice-Wheat	6.52±0.15	4.74±0.17	129.5±1.74	120.7±1.60	76.8±2.00	26.8±0.58	300.6±19.83	436.3±2.65	66.5±1.04	24.4±1.13
Sugarcane-sugarcane	8.32±0.15	6.32±0.17	156.8±1.75	117.6±1.52	26.0±0.71	14.4±0.60	229.5±1.43	234.3±1.15	127.8±1.77	72.2±1.57
Pearl millet-Wheat (Soil farm)	4.84±0.13	4.02±0.14	125.4±2.92	112.3±1.25	55.3±1.11	30.6±1.05	343.8±1.33	609.2±1.24	57.7±0.17	19.9±1.62
Horticulture										
Citrus	9.00±0.18	7.86±0.29	134.6±1.07	121.2±1.74	112.5±0.89	64.5±0.82	534.9±1.41	790.2±1.91	192.6±0.89	118.3±1.20
Guava	9.72±0.17	7.68±0.18	140.0±1.41	101.1±0.26	81.5±1.41	48.6±0.81	651.4±1.31	1395.2±1.85	196.3±0.80	104.9±1.65
Vegetables										
Tomato/ potato/ cauliflower/ brinjal	8.46±0.14	3.50±0.10	123.6±1.63	82.9±1.50	54.0±0.71	38.2±0.60	583.5±1.14	973.1±1.39	110.3±1.98	45.6±1.89

*[1] cultivated soils; *[2] uncultivated soils

Table 2: Available micronutrients content

Land use system (LUS)	**Available Zn ppm**		**Available Fe ppm**		**Available Cu ppm**		**Available Mn ppm**	
	***[1]C.S**	***[2]Un.S**	**C.S**	**Un.S**	**C.S**	**Un.S**	**C.S**	**Un.S**
Agriculture								
Cotton-Wheat	4.77±	3.63±	5.07±0.05	2.90±0.09	1.42±	1.03±	4.71±0.02	5.46±0.05
Rice-Wheat	3.19±	1.73±	32.34±0.71	26.45±0.48	2.50±	2.31±	4.78±0.19	11.47±0.29
Sugarcane-sugarcane	1.03±	0.69±	19.32±0.20	8.19±0.04	2.31±	1.58±	8.12±0.05	9.53±0.08
Pearl millet-Wheat (Soil farm)	2.55±	1.83±	6.57±0.09	4.51±0.08	1.30±	0.84±	9.25±0.14	12.42±0.32
Horticulture								
Citrus	3.13±	1.40±	4.03±0.02	4.08±0.01	1.23±	0.83±	7.81±0.13	5.55±0.29
Guava	3.10±	2.62±	5.65±0.11	2.46±0.02	1.53±	1.11±	6.47±0.35	6.37±0.19
Vegetables								
Tomato/ potato/ cauliflower/ brinjal	4.38±	2.46±	4.75±0.09	2.16±0.02	1.72±	1.47±	5.52±0.10	4.88±0.03

*[1] cultivated soils; *[2] uncultivated soils

Table 3: Physico chemical properties of soil

Land use system (LUS)	**pH**		**EC (dSm^{-1})**		**CEC (Cmolkg^{-1})**	
	***[1]C.S**	***[2]Un.S**	**C.S**	**Un.S**	**C.S**	**Un.S**
Agriculture						
Cotton-Wheat	7.91±0.01	8.13±0.04	0.44±0.02	0.77±0.04	12.0±0.56	8.1±0.46
Rice-Wheat	7.69±0.05	7.75±0.16	0.22±0.01	0.25±0.01	20.8±0.50	19.1±0.56
Sugarcane-sugarcane	7.76±0.02	7.95±0.04	0.25±0.01	0.26±0.01	19.6±0.53	19.4±0.42
Pearl millet-Wheat (Soil farm)	7.91±0.05	8.07±0.06	0.40±0.03	0.45±0.04	9.6±0.37	9.5±0.60
Horticulture						
Citrus	7.80±0.05	7.95±0.09	0.32±0.04	0.56±0.06	11.7±0.53	10.2±0.81
Guava	7.73±0.04	7.94±0.02	0.35±0.02	0.65±0.02	11.4±0.48	9.5±0.51
Vegetables						
Tomato/ potato/ cauliflower/ brinjal	7.90±0.03	7.96±0.08	0.33±0.01	0.67±0.01	10.6±0.57	9.3±0.64

*[1] cultivated soils; *[2] uncultivated soils

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