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Assessment of chemical properties under different land use systems with four year old cultivation

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Abstract
The main objective of this study was to assess the chemical properties of soils under different land use systems which were conducted at Bangaluru, Karnataka during 2015. Soil samples were collected at 0-15, 15-30, 30-50 and 50-100 cm from five horticultural areas (cultivated with mango, cashew, rose, vegetable and medicinal and aromatic crops), the soils of experimental site was sandy loam with slightly acidic to neutral in reaction. The results showed that all the available nutrients were higher in the surface soil (0-15 cm) which was decreased with increase in soil depth in all the selected horticulture crops. Mango and cashew orchard had the highest available N, P, K, Ca, Mg and sulphur as compared to the annual crops. The DTPA-extractable Fe, Zn, Cu and Mn were also higher in these soils (perennial crops).

Keywords: Land use systems, macronutrients, micronutrients

1. Introduction
Soil fertility is one of the important and fundamental factors that determine the productivity of all farming systems. Soil fertility is most commonly defined in terms of the ability of a soil to supply nutrients, which regulate growth and yield of the crops. It is more helpful to view soil fertility as an ecosystem concept integrating the diverse soil functions, including nutrient supply, which promote plant production.

Due to imbalance and inadequate uses of fertilizers, improper irrigation and various cultural practices the soil quality is depleting rapidly. For the sustainable horticultural production the information on soil characterization in relation to fertility status of the soils of the region will be useful. Therefore the present investigation was undertaken to study the chemical properties and available nutrient status of soils.

Growing of perennial horticulture crops is one of the strategies to improve soil conditions which would result in enhancing soil attributes and contributing to the good soil health. Although the benefits of perennial horticulture crops on soil in improving its chemical properties have been well known, information on the changes that would take place on shifting from one farming system to another farming system is lacking. Therefore the main objective of this study was to assess the soil chemical properties under diverse horticultural cropping systems.

2. Materials and Methods
The present investigation was carried out at the Regional Horticultural Research and Extension Center (RHREC), UAS Campus, GKVK, Bengaluru, Karnataka during 2015. The soil of the experimental site was sandy loam and classified as fine, mixed is other mic Kandic Paleustalf of Vijayapura soil series. Horticulture crops *viz.,* mango, cashew, rose, vegetables and medicinal and aromatic crops were selected for the experiment which was started in the year 2010 within the same locality. The experimental plots were permanently laid out for specified crops. There is no change either in the cropping system or in the fertilizer management practices since the planting. In each sampling site, soil samples were collected from four different depths *i.e.,* 0-15, 15-30, 30-50, and 50-100 cm.

Soil samples were processed by drying under the shade, powdering with a clean wooden mallet and passing through a 2 mm sieve. The processed samples were stored in polyethylene bags for analysis in the laboratory. The statistical analysis was done by using Randamized Complete Block Design (RCBD). The results were interpreted with organic matter.

Analysis of soil samples for chemical properties

2.1 Soil organic carbon (mg kg^{-1})

A known weight (0.5g) of 0.2mm sieved soil was treated with a known excess volume chromic acid ($K_2Cr_2O_7$ + H_2SO_4). After the oxidation of organic carbon, the unreacted $K_2Cr_2O_7$ left in the contents was back titrated with standard ferrous ammonium sulphate using diphenylamine indicator (Walkley and Black, 1934).

2.2 Available nitrogen (mg kg^{-1})

The alkaline permanganate method was adopted to assess the available nitrogen content in soils (Subbiah and Asija, 1956) [14].

2.3 Available phosphorus (mg kg^{-1})

Available phosphorus was extracted with Bray 1 solution in case of acid soils and Olsen's extractant in case of neutral and alkaline soils.

2.4 Exchangeable calcium and magnesium (C mol. (p+) kg^{-1})

The exchangeable Ca and Mg together (Ca + Mg) and exchangeable Ca alone were determined, by versenate titration method. EBT and Mureoxide indicators were used by maintaining the pH at 8.5 and >12 respectively using NH_4Cl-NH_4OH buffer and NaOH respectively (Page *et al.*, 1982) [12].

2.5 Available sulphur (mg kg^{-1})

The sulphate in the form of sulphur in soil was extracted using 0.15 percent $CaCl_2$ solution. The sulphate in the extract was determined by developing turbidity with $BaCl_2$ and the light transmitted was measured using Systronics Model Visiscan 167 spectrophotometer (Hesse, 1994) [5].

2.6 DTPA extractable micronutrients (mg kg^{-1})

The method developed by Lindsay and Norvell (1978) [8] using DTPA (Diethylene triamine penta acetic acid) was followed for the estimation of Zn, Cu, Fe and Mn. 10 g soil was shaken with 20 ml of (0.005M DTPA+0.1M TEA+0.01M $CaCl_2$) extractant for 2 hours and available micronutrients was measured using Atomic absorption spectrophotometer (Perkin Elmer model AAnalyst-200).

3. Result and Discussions

3.1 Soil organic carbon under different land use systems

The organic carbon content of soil was higher in the surface soil *i.e.,* 0-15 cm as compared to other subsurface layers of soil depth in all the cropping systems and the organic carbon content was decreased with increase in soil depth (Fig. 1). The carbon content differed significantly with different cropping systems, the mango orchard had higher organic carbon content *i.e.,* 6500.00, 6316.00, 5846.00, and 4611.00 mg kg^{-1} at 0-15 cm, 15-30 cm, 30-50 cm and 50-100 cm respectively, which was followed by cashew orchard. However, the medicinal and aromatic block showed lowest organic carbon 4300.00, 3916.00, 3834.00 and 3786.00 mg kg^{-1} at 0-15 cm, 15-30 cm, 30-50 cm and 50-100 cm depths respectively.

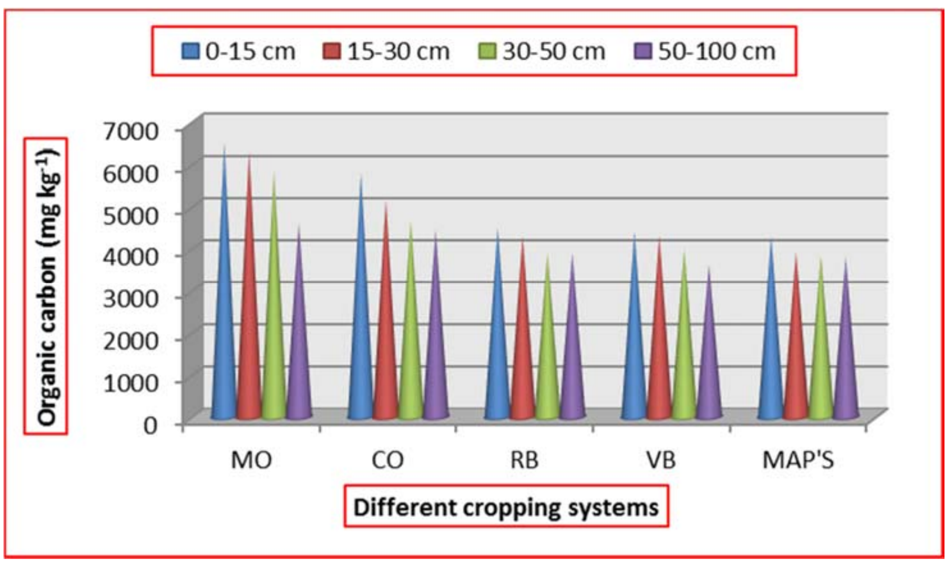

Fig 1: Organic carbon content at different depths as influenced by different horticulture crops. MO- Mango Orchard, VB- Vegetable Block, CO- Cashew Orchard, MAP's- Medicinal and Aromatic Plants, RB- Rose Block.

This is due to the continuous addition of organic matter in perennials crops like mango and cashew orchard leads to accumulate more organic matter to the soil.

Since organic manures are incorporated in to the surface and a major portion of the left over residues of shallow rooted crops usually accumulate in the top few centimetre of the soil layers, there was possibility for a relatively greater accumulation of organic carbon in 0-15 cm soil as compared to the soils of lower layer. Similar results were obtained by Manjaiah *et al*. (2000) [9]. Increase in soil carbon due to continuous addition of bio mass through leaf and roots have been reported by Geo Jose (2006) in case of field crops and by Krishnappa Naik *et al*. (1998) [7].

3.2 Available phosphorus under different land use systems

Available phosphorus content differed with different depth. 30-50 cm soil depth showed slightly higher values compared to other depth and lowest values were obtained in the 50-100 cm (Table 1). Among different cropping system, the vegetable block had significantly higher value (23.16 mg kg^{-1}) which is on par with the rose block (22.10mg kg^{-1}).

Table 1: Available Phosphorus content at different depths as influenced by different horticulture crops

Horticulture land use system	4 year old cultivation			
	Available Phosphorus (mg kg^{-1})			
	0-15 cm	15-30 cm	30-50 cm	50-100 cm
Mango orchard	19.56	19.55	20.14	19.00
Cashew orchard	17.55	17.53	21.71	17.22
Rose block	22.86	22.81	23.46	22.10
Vegetable block	22.41	22.40	24.56	23.16
Medicinal and aromatic block	18.46	18.50	20.13	20.16
SEm ±	1.76	1.83	0.78	1.80
CD at 5%	5.21	5.31	2.75	5.86

This might be due to higher organic biomass and their subsequent decomposition for buildup of phosphorus under the perennial crops. Dhaliwal *et al.* (2008).Guppy *et al.* (2005) reported that the incorporation of organic matter, that rapidly sorb applied phosphorus, increases P availability to plants. It was noticed that incubation of organic matter in soil, reduced phosphorus sorption. However, the decrease in phosphorus sorption was not related to competition from the decomposition products of organic matter, but was the result of phosphorus release from the organic matter.

3.2 Available potassium under different land use systems

The available potassium was recorded maximum at 0-15 cm soil depth as compared to subsurface soil depth (Table 2). Among different systems, rose blocks (101.45 mg kg^{-1}) showed significantly higher value of available potassium which is on par with the vegetable block (99.56 mg kg^{-1}) in four year old cultivated soil and lower available potassium content was observed in medicinal and aromatic block (94.56 mg kg^{-1}).

Table 2: Available Potassium content at different depths as influenced by different horticulture crops.

Horticulture land use system	4 year old cultivation			
	Available potassium (mg kg^{-1})			
	0-15 cm	15-30 cm	30-50 cm	50-100 cm
Mango orchard	98.56	98.13	97.14	97.14
Cashew orchard	97.45	97.45	97.13	97.00
Rose block	101.45	101.38	100.98	100.93
Vegetable block	99.56	99.53	99.32	99.16
Medicinal and aromatic block	94.56	94.53	94.51	94.53
SEm ±	2.15	2.10	2.08	2.01
CD at 5%	6.55	6.44	6.31	6.21

3.3 Available sulphur under different land use systems

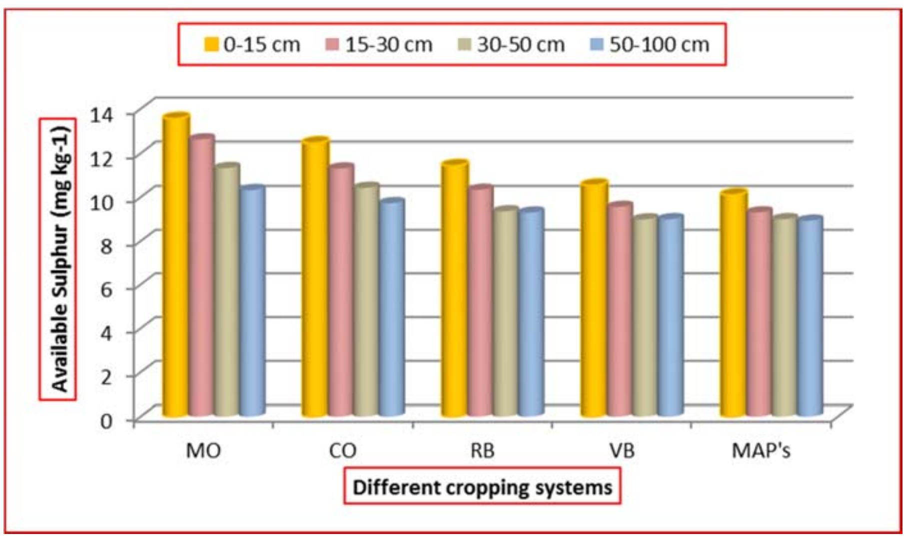

Fig 2: Available sulphur content at different depths as influenced by different horticulture crops.

MO- Mango Orchard, VB- Vegetable Block, CO- Cashew Orchard, MAP's- Medicinal and Aromatic Plants, RB- Rose Block.

The highest sulphur content was obtained in the 0-15 cm and lowest was observed in the 50-100 cm depth and the sulphur content decreased with increase in soil depth. Among different cropping systems, the sulphur content showed non-significant results in 30-50 cm and 50-100 cm layer of the soil but showed significant results at 0-15 cm and 15-30 cm soil depth. The mango orchard showed significantly higher result (12.45 mg kg^{-1}) which is on par with the cashew orchard (12.45 mg kg^{-1}) and rose block (11.44 mg kg^{-1}). However, lowest sulphur content was observed in medicinal and aromatic block (10.11 mg kg^{-1}) in four year old cultivation.

3.4 Zinc, copper, manganese and iron content under different land use systems

All the DTPA-extracted micronutrient viz., Zn, Cu, Mn and Fe were found sufficient in surface soils of selected different horticulture crops. It was observed that there is decreased in the contents of all the micronutrient with increase in depth. DTPA- Zn ranges from 1.50 mg kg^{-1} at 0-15 cm under mango orchard to 0.34 mg kg^{-1} at 50-100 cm soil depth in medicinal and aromatic block. DTPA-Cu ranges from 1.42 mg kg^{-1} at 0-15 cm in vegetable block to1.11mg kg^{-1} at 50-100 cm soil depth under medicinal and aromatic block (Table3). DTPA-Mn ranges from 141.15 mg kg^{-1} at 0-15 cm in vegetable block to126.14mg kg^{-1} at 50-100 cm soil depth under cashew orchard (Table4). DTPA-Fe ranges from 59.46 mg kg^{-1} at 0.15

cm in mango orchard to 47.22mg kg^{-1} at 50-100 cm soil depth under cashew orchard after four year cultivation.

Table 3: Zinc and Copper content at different depths as influenced by different horticulture crops.

Horticulture land use system	4 year old cultivation							
	Zinc (mg kg^{-1})				Copper (mg kg^{-1})			
	0-15 cm	15-30 cm	30-50 cm	50-100 cm	0-15 cm	15-30 cm	30-50 cm	50-100 cm
Mango orchard	1.50	1.81	0.64	0.48	1.33	1.30	1.23	1.15
Cashew orchard	1.10	1.61	0.72	0.44	1.24	1.20	1.22	1.17
Rose block	1.26	1.34	0.68	0.53	1.36	1.38	1.26	1.15
Vegetable block	1.31	1.72	0.56	0.44	1.42	1.40	1.34	1.12
Medicinal and aromatic block	1.10	1.52	0.44	0.34	1.29	1.26	1.20	1.11
SEm ±	0.11	0.14	0.10	0.06	0.08	0.08	0.06	0.03
CD at 5%	0.33	0.41	0.31	0.16	NS	NS	NS	NS

Table 4: Zinc and Copper content at different depths as influenced by different horticulture crops

Horticulture land use system	4 year old cultivation							
	Manganese (mg kg^{-1})				Iron (mg kg^{-1})			
	0-15 cm	15-30 cm	30-50 cm	50-100 cm	0-15 cm	15-30 cm	30-50 cm	50-100 cm
Mango orchard	133.56	133.51	132.56	130.14	59.46	59.33	58.09	57.13
Cashew orchard	128.56	128.43	127.41	126.14	48.48	48.95	48.22	47.22
Rose block	136.45	136.13	137.12	137.21	58.45	58.19	58.02	57.99
Vegetable block	141.15	141.32	140.78	140.80	56.46	56.37	56.89	55.82
Medicinal and aromatic block	130.15	130.12	129.13	128.91	49.45	49.92	48.04	47.55
SEm ±	3.88	3.68	4.01	4.23	3.00	3.32	3.26	3.26
CD at 5%	11.24	11.24	12.41	13.21	9.11	10.00	9.88	9.88

This might be due to the DTPA-Zn and DTPA-Cu are found higher in perennials compared to annual cropping system. Biomass recycling and chelation reactions in forest soils might have enhanced Zn and Cu contents (Jordan, 1985; Stevenson, 1994) [6]. Similar reports on higher Fe and Mn extractability were reported in tropical forests of Andaman and Nicobar Islands (Dagar *et al*, 1995). Soil reaction and organic matter contents are two important factors in regulating micronutrients availability (Lindsay and Norwell, 1978; Stevenson, 1994) [8, 13]. DTPA extractable Fe and Mn also showed similar trend as that of Zn and Cu with a few exceptions in annual crops. The soils of mango and cashew orchards recorded significantly higher amounts of Fe and Mn. The differences in available Fe content might be due to the accelerated nutrient removal by crop under varying land uses and crop intensification. The available Fe below sufficiency range particularly under sapota, vegetable and floriculture suggests that Fe deficiency symptoms may develop in near future unless replenishment is done through addition of organic matter or some other means (Sharma, 2001).

4. Conclusion
From this study, all the available nutrients and micronutrients were recorded maximum by cultivation of perennial crops at the surface soil than annual crops.

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