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Soil Chemical Properties under Different Horticultural Cropping Systems with Different Depth

Bhavya V. P.*, Anil Kumar S., Ashok Alur, Shivakumar K. M. and Shivanna M.
Department of Soil Science and Agricultural Chemistry, College of Horticulture, Bengaluru-560 065, Karnataka
*Corresponding Author E-mail: ammushetty1993@gmail.com

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ABSTRACT

The main objective of this study was to assess the chemical properties of soils under different a cropping system which was conducted at Bengaluru, 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 at surface soil (0-15 cm) which was decreased with increase in soil depth in all the selected horticultural crops. Mango and cashew 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).

Key words: *Cropping systems, Macronutrients, Micronutrients.*

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, but 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.

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MATERIAL AND METHODS

The present investigation was carried out at horticulture division, UAS Campus, GKVK, Bengaluru, Karnataka during 2015. The soil of the experimental site was sandy loam and classified as fine, mixed isothermic Kandic Paleustalf of Vijayapura soil series. Horticulture crops *viz.*, mango, cashew, rose, vegetables and medicinal and aromatic crops were selected for the experiment within the same locality. The experimental plots were permanently laid out for specified crops. 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

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.

Available nitrogen (mg kg^{-1})

The alkaline permanganate method was adopted to assess the available nitrogen content in soils[14].

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.

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[12].

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[5].

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

The method developed by Lindsay and Norvell[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).

RESULTS AND DISCUSSIONS

Soil organic carbon under different land use systems

The organic carbon content of soil was higher at 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 system, the mango orchard had higher organic carbon content *i.e.*, 7500.00, 7334.00, 7016.00, and 6743.00 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 4521.00, 4311.00, 4008.00 and 3933.00 mg kg^{-1} at 0-15 cm, 15-30 cm, 30-50 cm and 50-100 cm depths respectively.

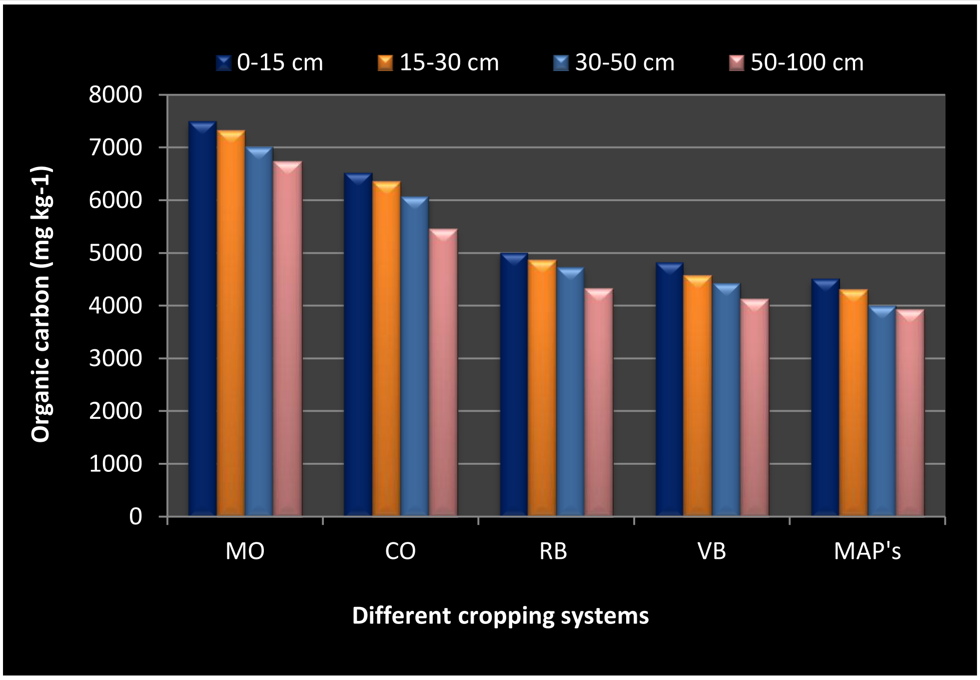

Fig. 1: Organic carbon content at different depths as influenced by different horticulture crops

MO- Mango Orchard, VB- Vegetable Block, CO- Cashew Orchard, MAP's- Medicinal and Aromatic Plants, RB- Rose Block. This is due to the continuous accumulation of organic matter under perennials crops like mango and cashew orchard leads to add 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*[9]. Increase in soil carbon due to continuous addition of bio mass through leaf and roots have been reported by Geo in case of field crops and by Krishnappa Naik *et al*[7].

Available nitrogen under different land use systems

The available nitrogen was recorded maximum at 0-15 cm soil depth as compared to subsurface soil depth (Table 1). Among different systems, vegetable blocks (124.45 mg kg^{-1}) showed significantly higher value of available nitrogen which is on par with the cashew (122.85 mg kg^{-1}), rose block (121.64 mg kg^{-1}) and lower content was observed under medicinal and aromatic block (101.62 mg kg^{-1}).

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

Horticulture land use system	**Available nitrogen (mg kg^{-1})**			
	0-15 cm	15-30 cm	30-50 cm	50-100 cm
Mango orchard	122.85	118.31	109.30	100.56
Cashew orchard	105.34	100.31	96.83	93.71
Rose block	121.64	115.43	108.31	96.88
Vegetable block	124.45	118.18	102.43	95.43
Medicinal and aromatic block	101.62	96.41	94.31	92.78
SEm ±	6.45	6.54	4.71	2.33
CD at 5%	20.16	20.11	NS	NS

Available phosphorus under different land use systems

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

Horticulture land use system	**Available Phosphorus (mg kg^{-1})**			
	0-15 cm	15-30 cm	30-50 cm	50-100 cm
Mango orchard	26.56	26.53	28.76	26.53
Cashew orchard	24.45	24.41	26.31	24.00
Rose block	24.87	24.83	26.53	24.32
Vegetable block	25.15	25.78	27.34	25.13
Medicinal and aromatic block	24.51	24.53	26.34	24.00
SEm ±	0.71	0.82	0.96	0.86
CD at 5%	NS	NS	NS	NS

Available phosphorus content was found to be non-significant with respect to cropping system in all depth.

Available potassium under different land use systems

Table: 3 Available Potassium content at different depths as influenced by different horticulture crops

Horticulture land use system	**Available potassium (mg kg^{-1})**			
	0-15 cm	15-30 cm	30-50 cm	50-100 cm
Mango orchard	100.56	100.31	100.51	99.56
Cashew orchard	104.45	104.11	104.00	104.23
Rose block	121.52	122.66	121.63	121.73
Vegetable block	102.60	103.60	103.11	102.71
Medicinal and aromatic block	112.62	113.73	112.33	113.47
SEm ±	6.44	6.84	6.51	6.85
CD at 5%	18.56	21.11	20.11	21.11

The available potassium was recorded maximum at 15-30 cm soil depth as compared to subsurface soil depth (Table 3). Among different systems, rose blocks (122.56 mg kg^{-1}) showed significantly higher value of available potassium which is on par with the vegetable block (103.66 mg kg^{-1}), cashew orchard (104.11) and lower available potassium content was observed under mango orchard (100.31mg kg^{-1}).

Exchangeable calcium, magnesium and available sulphur under different land use systems

The study showed that, the exchangeable calcium and magnesium was found to be non significant with respect to cropping system in all depth.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 cashew orchard showed significantly higher result (23.45 mg kg^{-1}) which is on par with the mango orchard (21.56 mg kg^{-1}) and rose block (21.34 mg kg^{-1}). However, lowest sulphur content was observed in vegetable block (20.25 mg kg^{-1}).

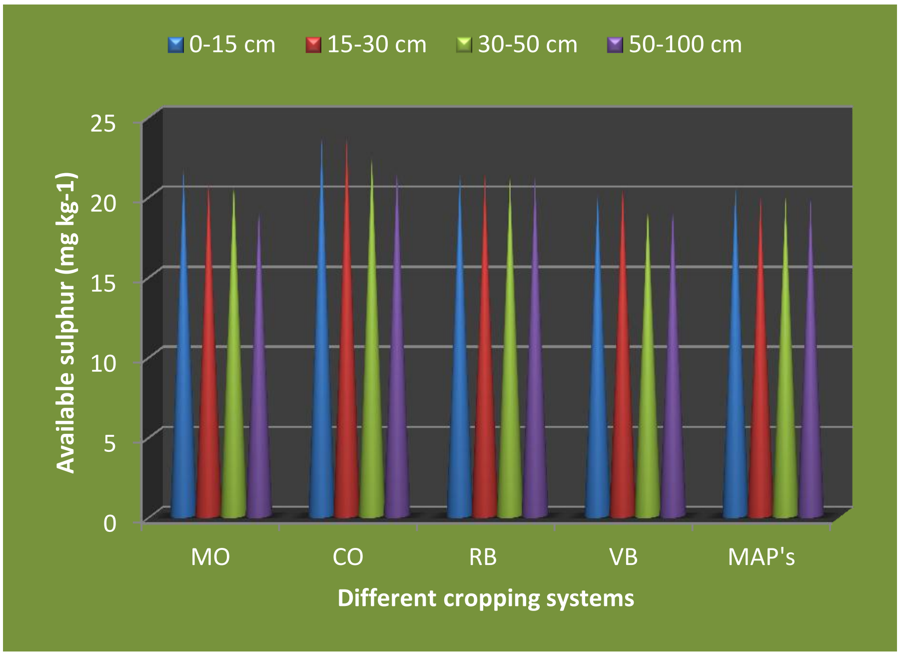

Fig. 2: Available sulphur content at different depths as influenced by different horticulture crops

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

3.6 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. Among different cropping systems, the Zn content showed non-significant results in 15-30, 30-50 and 50-100 cm layer of the soil but showed significant results at 0-15 cm soil depth. The cashew showed significantly higher result (62.45 mg kg^{-1}) which is on par with the mango (62.25 mg kg^{-1}). However, lowest Iron content was observed under rose block (58.41 mg kg^{-1}) (Table 4).DTPA-Cu was found to be non-significant with respect to cropping system in all depth (Table 4)

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

Horticulture land use system	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	2.58	2.58	2.31	1.63	2.53	2.11	2.11	1.96
Cashew orchard	2.66	2.62	2.12	1.51	2.64	2.10	2.10	1.98
Rose block	2.16	2.10	2.06	1.60	2.32	2.16	2.12	1.92
Vegetable block	2.52	2.52	2.01	1.48	2.52	2.17	2.17	1.64
Medicinal and aromatic block	2.51	2.20	1.96	1.49	2.31	2.14	2.13	1.78
SEm ±	0.13	0.16	0.13	0.05	0.12	0.03	0.03	0.14
CD at 5%	0.41	NS	NS	NS	NS	NS	NS	NS

The highest Iron content was obtained in the 0-15 cm and lowest was observed in the 50-100 cm depth. Among different cropping systems, the Iron 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 vegetable block showed significantly higher result (62.45 mg kg^{-1}) which is on par with the rose block (62.41 mg kg^{-1}) and mango orchard (62.25 mg kg^{-1}). However, lowest Iron content was observed under medicinal and aromatic block

(58.41 mg kg^{-1}) (Table 5).The highest manganese content was obtained in the 0-15 cm and lowest was observed in the 50-100 cm depth. Among different cropping systems, the medicinal and aromatic block showed significantly higher result (150.56 mg kg^{-1}) which is on par with the vegetable block (150.19 mg kg^{-1}) and rose block (144.55 mg kg^{-1}). However, lowest Iron content was observed under mango orchard (141.46 mg kg^{-1}) (Table 5).

Table 5: Manganese and Iron content at different depths as influenced by different horticulture crops

Horticulture land use system	**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	141.46	141.13	140.81	140.78	62.25	62.25	61.86	60.68
Cashew orchard	142.62	141.31	141.40	140.38	58.81	58.81	59.86	58.91
Rose block	144.55	143.78	142.52	141.66	62.41	62.41	61.07	60.83
Vegetable block	150.19	149.53	149.51	148.71	62.45	62.12	61.82	60.73
Medicinal and aromatic block	150.56	150.31	149.51	149.63	58.41	58.62	58.66	57.58
SEm ±	2.22	2.21	2.18	2.32	1.33	1.28	0.80	1.10
CD at 5%	8.23	8.25	8.12	8.88	4.21	4.33	NS	NS

This might be due to the DTPA-Zn and DTPA-Cu is found higher in perennials compared to annual cropping system. Biomass recycling and chelation reactions in forest soils might have enhanced Zn and Cu contents[6,13]. Similar reports on higher Fe and Mn extractability were reported in tropical forests of Andaman and Nicobar Islands. Soil reaction and organic matter contents are two important factors in regulating micronutrients availability[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.

CONCLUSION

From this study, all the available macronutrients and micronutrients were recorded maximum at surface soil under perennial crops than annual crops.

REFERENCES

1. Bray, r. H. And kurtz, L. T., Determination of total, organic and available forms of phosphorus in soils. *Soil Sci*., **59:** 39-47 (1945).
2. Chang, E. H., Chung, R. S. And Wang, F. N., Effect of different types of organic fertilizers on the chemical properties and enzymatic activities of an oxisols under intensive cultivation of vegetables for 4 years. *Soil Sci. and Plant. Nutr.,* **54:** 587-599 (2008).
3. Dhaliwal, S. S., Shrama, B. D., Singh, B. And Khera, K. L., Profile distribution of chemical, physical and microbial characteristics in four land use systems of Sadh Di Khad watershed in sub mountainous tract of Punjab. *Asian J. Soil Sci* **3(2):** 316-322 (2008).
4. Guppy, C. N., menzies, N. W., Moody, P. W. And Blamey, P. C., Competitive sorption reactions between phosphorus and organic matter in soil. *Aus J. Soil Res*., **43:** 189-202 (2005).
5. Hesse, P.R., *A text Book of Soil Chemical Analysis*. CBS publishing House, New Delhi, India. 720 (1994).
6. Jordan, C.F., *Nutrient Cycling in Tropical Forest Ecosystems*. Wiley, Chichester, USA (1985).

7. Krishnappa Naik, C. S., Haricharan, B. R., Jayarama. And Surendra Swamy, H. B., Coffee soils of Chikmagalur district. *Indian Coffee.*,**52(10):** 3-9 (1998).
8. Lindsay, W. L. and Norwell, W. A., Development of a DTPA soil test for Zn, Fe, Mn and Cu. *Soil Sci. Soc. Amer. J.* **42:** 421-428 (1978).
9. Manjaiah, K. M., Voroney, R.P., and Sen, U., Soil organic carbon stocks, storage profile and microbial biomass under different crop management systems in a tropical agricultural ecosystem. *Biol. Fertil. Soils*., **31:** 273-278 (2000).
10. Nagaraj, M. S. Biomass turnover, nutrient status and biological processes in different land use systems. *M.Sc. (Agri) Thesis*, UAS, Bengaluru (1997).
11. Olsen, S. R., and Cole, C. V., Watanable, F. S. And dean, L. A., Estimation of available phosphorus in soils by extraction with sodium bicarbonate. USDA, Washington Dc. Circular. 939 (1954).
12. Page, A. L., Miller, R. H. and Keeney, D. R., 1 *Methods of soil analysis*, Part II (2nd ed) in the series Agronomy. *American Soc. Agron Inc* (1982).
13. Stevenson, F. J., *Humus Chemistry: Genesis, Composition And Reactions.* John Wiley and Sons, New York (1994).
14. Subbaiah, B. V. and Asija, G. L., A rapid procedure for the estimation of available nitrogen in soils. *Current Sciences*, **25:** 259-260 (1956).