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Research Article

EFFECT OF CULTIVATION OF CITRUS ON SOIL ORGANIC CARBON AND NUTRIENT STATUS

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Abstract- Citrus is grown on a large scale in sub-tropical region and it is a rich source of vitamin C. India being the third largest producer, the impact of cultivation of citrus fruit on soil properties is important to study. Haryana account a large contribution in the production of citrus. Long term cultivation imparts certain physico-chemical changes in the soil and also enhances the nutrients of the soil. The experiment conducted revealed that the content of organic carbon increases 14.50% in the soil under long term cultivation of citrus as compared to the soil of control site (path) near the field. It also decreases the pH and EC of the soil and enhances the content of both macro and micro nutrients. However, the content of iron and potassium decreases in the cultivated soil as compared to uncultivated soil. Thus from the study, it was concluded that cultivation of citrus in long term basis enhances the soil health.

Keywords- Citrus, Soil Health, Physico-Chemical, Long Term, Control Site

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Introduction

Citrus is an important sub-tropical fruit crop. Citrus occupy third position after mango and banana in the production of fruits in India. Presently, area under citrus cultivation in India is 987.6 kha while in Haryana it is 13.8 kha with 9637.8 Mt and 98.3 Mt productions respectively. In Haryana, Kinnow is major variety grown and leading districts in citrus production are Hisar, Sirsa and Fatehabad. Mandarin (*C. reticulata*) is major citrus group grown throughout the world because of its high demand in market [1]. Continuous cultivation of citrus in the well established orchard leads to several changes in the soil in terms of physico-chemical properties as well as its nutrient status. Recent studies have shown that soil nutrients and water availability changed significantly under long-term cultivation of *C. reticulata*. In particular, long-term cultivation of *C. reticulata* directly increases soil organic carbon (SOC) and total nitrogen (TN) *via* the input of soil organic matter (SOM) from litter decomposition and below-ground biomass turnover [2]. It was found that 16.82×10^5 g litter/hm^2 per year can be produced by a mature *C. reticulata* and about 80% of this litter was decomposed within one year [3]. Moreover, field observations also reported that mature C. *reticulata* could reduce runoff by about 33%-95% due to the high water-holding rate of soil caused by citrus litter [4]. Soil organic matter, of which carbon is a major part, holds a great proportion of nutrients, cations and trace elements that are of importance to plant growth. The soil organic carbon affects important functional processes in soil like the storage of nutrients, mainly N, water holding capacity, and stability of aggregates [5]. Soil nitrogen has been assessed mainly as mineral N, especially nitrate, organic N or potentially mineralizable N, as stored in the soil organic matter. The stagnation in crop productivity has been found due to deficiency of nutrients especially micronutrients as they play an important role in physiological processes in crop plants which is directly linked with yield parameters which is influenced by land use systems [6].

Materials and Methods

The present experiment was carried out in Department of Soil Science, CCS Haryana Agricultural University, Hisar.

Soil Sampling: The soil samples were collected from the citrus orchard located at Research Farm, Dept. of Horticulture with latitude: 29° 10' N and longitude: 75° 46' E. The soil texture of the sampled field was sandy loam and annual temperature and average rainfall of the site is 1.9°C and 450 mm respectively. Soil samples were collected from citrus orchard with the circular band of 30 to 40 cm wide under beneath the perimeter of the tree. These samples were labeled as cultivated. Soil samples were also collected from the path near to the orchard as a control. These samples were air dried in shade, ground gently by wooden pestle and mortar sieved through 2mm sieve for determination of available nutrients and through 0.2mm sieve for organic carbon estimation. Thus processed samples of 2mm and 0.2mm size were duly labeled and stored in clean polyethylene bags for further analysis.

Methodology used to determine available nutrients:

Parameter	Method	Reference
pH (1:2::Soil:water suspension)	Potentiometric method	7
EC (1:2::Soil:water suspension)	Conductometric method	7
Soil 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

Statistical Analysis

The data obtained under various studies was subjected to statistical analysis for significance using ANOVA as suggested by [14]. Least square difference was used to compare the treatment effect at P<0.05.

Results and Discussion

The soil samples collected were analysed for pH, EC, organic carbon content and available nutrient status. The result showed that the nutrient status of the soil under cultivation was higher than the soil samples of control site. The results of the physico-chemical parameters are showed in the table given below:

Table-1 *Status of physico-chemical properties of soil under citrus cultivation*

Soil samples	Parameters		
	pH	EC (dSm^{-1})	OC (g/kg)
Control (Path)	7.95	0.56	7.86
Cultivated (Citrus orchard)	7.80	0.32	9.00

The results above showed that the organic carbon content was 14.50% higher under cultivated soil as compared to path soil. This may be due to higher addition of organic matter in the orchard through continuous litter fall. The pH and EC of the orchard soil was reported lower as compared to the path soil. 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, 16], who reported decrease in pH with the addition of organic residue and manure due to production of organic acid in fertilized plot over control. The lower EC of the citrus orchard may be attributed to frequent irrigation application in the orchard which flushes out the dissolved salts deeper in soil. This result was in consistent with [6] who concluded higher EC in irrigated field than rainfed cropping system and reported higher EC under agri-horticulture system as compared to perennial vegetation.

It was observed from the study that all the macro nutrients except potassium and all the micronutrients except iron were found to be increase in the cultivated soil as compared to uncultivated (control) soil [Table-2].

Table-2 *Status of available macro and micro nutrients in soil of citrus orchard.*

Soil samples	Parameters (Kg/ha)							
	Avl N	Avl P	Avl K	Avl S	Avl Zn	Avl Mn	Avl Fe	Avl Cu
Control (Path)	121.2	64.5	790.2	118.31	1.40	5.55	4.08	0.83
Cultivated (Citrus orchard)	134.6	112.5	534.9	192.62	3.13	7.81	4.03	1.23

The available nitrogen was found 11% higher in soil of citrus orchard in comparison to the uncultivated path soil. Similarly, the content of available phosphorus, sulphur, zinc, manganese and copper was found 74.4%, 62.80%, 123%, 40% and 48% respectively higher than the controlled samples. This may be due to higher and frequent litter fall in the orchard leads to higher addition of organic matter. The decomposition of organic matter is a slow and gradual process which builds up the organic form of these nutrients which on mineralization releases nutrients in the soil. Another reason was providence of better managerial practices and inclusion of fertilizers and manure favour the buildup of nutrients in the orchard soil. Regular tillage practices enhance the releases of the various nutrients. The increased available N in soils of Haryana under different cropping system with the application of fertilizers and manures was also reported by several workers [17-19]. Similar results were obtained by several workers as [20,16,21]. However, the content of available potassium and iron was lower in orchard soil as compared to path or uncultivated soil. This may possibly due to higher mining of potassium in cultivated soils and no addition of potash fertilizers. These results are in agreement with findings of [20] who reported higher amount of available K in barren land in comparison to cultivated conditions of maize. In contrast to above findings [22] reported higher K content under agriculture cultivated land than wasteland.

Conclusion

The experiment conducted to study the effect of cultivation on soil physico chemical properties as well as nutrient status of the soil. Citrus cultivation causes several changes in the soil properties. Organic carbon and available N, P, S, Zn, Mn and Cu increases in the orchard soil while available K and Fe decrease. The pH and EC of orchard soil also decreases as compared to path soil. Thus, instead of barren soil, cultivation increases the soil nutrient status as well as improves its physical condition.

Abbreviations: SOC- soil organic carbon, EC- electrical conductivity, SOM-soil organic matter, TN- total nitrogen, DTPA- Diethylenetriaminepentaacetic acid, ANOVA- Analysis of variance, N- nitrogen, P- phosphorus, K- potassium, S-sulphur, Zn- zinc, Mn- manganese, Cu- copper, Fe- iron.

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Conflict of Interest: None declared

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