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Soil Fertility Recommendations in Relation to Crop Productivity Across different Tea Growing Regions of the Nilgiris

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Abstract: ***Maintenance of soil health is an important factor that influences crop productivity in small growers' tea gardens in the Nilgiris. An attempt was made to analyze the data of Nilgiri soils and to establish the small growers' receptivity on recommendations issued by UPASI Scientific Department. Soil pH of the small growers' gardens ranged from very low to medium level where most of the soil samples analysed indicated that the soils were extremely acidic. Less than 8% of the soil recorded as high EC values which indicated that the extent of adoption of recommendations was very poor. About 65% of the soils registered low organic matter (OM) while 32% possessed medium OM. Organic matter levels are known to affect physico-chemical properties of the soil. Problem of imbalanced fertilizer use has also been stressed on three interpretations, with intensive cropping, nutrient removal by crops from soil and exceeded replenishment through chemical fertilizers. These factors causing imbalance of soil nutrients and thereby soil health. The study revealed that there is lack of awareness among small growers with reference to importance of adoption of cultural operations besides integrating the farming practices in view food safety and environmental concerns. There is an ample scope for addition of soil organic manures to improve the soil health and to enhance crop productivity.***

Keywords: soil health, organic manure, organic matter

1. Introduction

The tea district has the largest area belonging to small growers and their contribution is phenomenal while considering the district annual production. There is a stagnating trend in crop productivity especially in the Nilgiris, where the productivity level remained the same or declined considerably due to one or other reasons. Small growers experience a number of technological and socio-economical constraints in adopting the recommended production know-how. Conservation of soil health and nutrient management is important criteria for crop productivity. Even though the physico-chemical characteristics of the soils are varied between different agro climatic conditions, the soil health can be preserved by adopting the recommended package of practices by UPASI Tea Research Institute and by the Krishi Vigyan Kendra [1].

Soil properties, particularly, pH and EC are the principle components in the soil analysis and indicate the soil chemical reactions. Soil organic matter in other words organic carbon and available nitrogen is important for sustained crop productivity. Even though organic matter content does not show significant relationship with crop productivity, its interaction with other nutrients contributes towards crop productivity. Earlier a few case studies were executed to analyze the extent of adoption of recommendations by the small growers of the Nilgiri district. By and large the case study deals primarily with receptivity of recommended package of practices on crop productivity. None the less, earlier study was not attempted at grass root level of scientific aspects like soil health and nutrient management (Ramu *et al*., 2000). In this concern, the present study deals with the farmers' receptivity of recommended package of practices on soil health management across the Nilgiri district in view of improving the soil organic matter

2. Methodology

The study was primarily based on the data on soil analytical parameters like pH (soil reaction/hydrogen ion concentration), EC (electrical conductivity), OM (organic matter content), OC (organic carbon) and soil available N (nitrogen). The analytical data were pertaining to three different agro climatic zones of the Nilgiris, viz., Ooty, Coonoor and Kotagiri. Soil samples received and analyzed for the above parameters only were considered as the database. There were 206 soil analytical data comprising Ooty (62), Coonoor (48) and Kotagiri (96) regions, irrespective of the farm size. Soil analysis was performed at chemical laboratory at UPASI KVK and suitable recommendations were sent to the farmers for adoption. Based on the organic matter content, soil organic carbon, and available nitrogen were derived according to the standard protocol. Results were subjected to class interval analysis and presented. On the basis of the results, interim measures to be adapted to retain the soil health and sustain the crop productivity were discussed.

3. Results and Discussion

Lesser level of transfer of technology pertaining to nutrient management practices are very often attributed for lower productivity in small growers' sector. Soil analytical reports

revealed that varying degree of soil physical and chemical parameters across the Nilgiris. Considering the total number of small growers' in the district (approximately 75,000 small holdings), soils received for analysis from the farmers is negligible. Though small growers are aware of tea cultivation through constant approach with scientific community, they are not familiar with the importance of soil analysis in relation to soil fertility. However, they are keen to identify the problem when they face the yield stagnation or nutritional deficiency symptoms arise.

Small growers' receptivity of agricultural practices ranged from very low to medium level with respect to soil pH conditions. Majority of the soils (56.3%) are extremely acidic (pH <4.5), irrespective of the regions. Only 32.5% of soil samples with optimum/preferable pH range (4.5-5.5). Remaining samples were either near neutral or alkaline in nature (Table 1). According to the number of samples in the respective group, relative distribution of three different regions showed different trend. However, per cent distribution in accordance with samples and its categorization followed identical trend in all the three regions.

Remedial measures to adjust the soil pH are also recommended accordingly by UPASI TRI (Verma and Palani, 1997; UPASI:KVK, 2004). When the soil pH goes below 3.9, chemical decay occurs where the clay minerals are broken down with release of oxides of iron and alumina which in turn lead to poor nutrient holding capacity and aeration (Ranganathan and Swaminathan, 1972). Extremely acidic pH indicates improper soil sampling which include sampling immediately after fertilizer application. In general, soils of the organic farming have near neutral pH; otherwise the inorganic fields fertilized improperly or without fertilizer application only show near neutral soil reaction. In the present survey, about 11% of the soils are near neutral or alkaline in nature which indicates the small grower's lack of knowledge on soil health management.

Based on the electrical conductivity (EC), soils can be classified into soils with normal EC, high EC and very high EC. Since the unit of measure for classification was too wide, most of the tea soils come under normal category (Table 2). About 14% of Ooty soils exhibited either high or very high EC values followed by Coonoor soils. Out of 96 Kotagiri soils, only three were registered high EC values.

In general, organic matter content of the soils are classified as low, medium and high based on the elevation where Coonoor and Kotagiri being located between 1500 and 2000 m above MSL. Under the circumstances, Ooty soils should contain between 7.8 and 13.0% under medium category and greater than 13.0% is regarded as high soil OM. On the other hand, both Coonoor and Kotagiri soils should contain 5.2 to 10.4% under medium and greater than 10.4% under high OM category, respectively. Irrespective of the regions, 65% of soils analyzed regarded as low category (Table 3). Only 3.0% of the soils represented high OM content and remaining 32% comes under medium OM category.

As OC and OM had a significant positive correlation, except a minor deviation, relative distribution of OC mimics the pattern identical to that of OM (Table 4). Soils with OC <3.0% classified under low category while 3.0-6.0% considered as medium and >6.0% as high OC. Based on the above classification, irrespective of the regions, 67% of soils analyzed with low OC values (Table 4). Only 2.4% of the soils with high OC and remaining 30.6% considered as medium category. Soils with low and medium OC content should be improved to high category to sustain the soil health. These soils have a huge potential to accumulate organic carbon as organic manures.

Available N classification is entirely different from OM categorization. There had been a wide variation existed on the basis of range of available N (Table 5). Majority of the soils (76.7%) registered low level of available N while another 15.5% possessed medium level. Only 7.8% of soils contained higher level of available N.

Nutrient management strategies have undergone several changes over the years (Verma, 1993a,b). Results of the earlier studies demonstrated that the continuous intensive agricultural practices could impair the soil health, create problems of alkalinity/salinity and deteriorate soil texture as observed in the present study. Deliberate loss of soil fertility due to the continuous extraction of nutrients that surpasses the input application and management of organic matter is causing concern (Kumar *et al*., 1998). Organic matter levels are known to affect physico-chemical properties of the soil (Jitendra P.Srivastava and Madhuchhanda Mukhopadhyay, 1997). Improper fertilizer management in small growers' gardens reflected up on physical properties of the soils and primarily the soil OM. If this trend continues, a serious threat persists for sustainable crop productivity in tea. Even though the study is not dealing with crop productivity, the present level of crop production is alarming and it is time to streamline the research/extension activities to evolve holistic strategies for sustained crop productivity.

Improvement in soil organic matter resulted in higher water holding capacity while other nutritional factors enhanced considerably (Boody, George and Mara Krinke, 2001). There is a lot of scope in improving the soil fertility of these regions adopting the recommended cultural operations like application of organic manures and there is a tremendous potential for retention of pruning/recycling of organic wastes of the gardens. Tea being a voracious nutrient extractor, application of fertilizers in appropriate time is warranted where integration of chemical, organic and biofertilisers play an important role. The study revealed that there is lack of awareness among small growers on soil health particularly integration of biological, cultural and natural inputs to create an ecological balance.

Results revealed that the extent of adoption of recommendations on soil health management was very poor in all the zones across the Nilgiris. Sampling error is yet another

factor which has to be addressed at this juncture. Soil sampling immediately after fertilizer application and without following the standard methodology will always lead to erroneous results. Proper guidance is very essential to resolve the problem. There was a myth that small growers have not adopted the recommended package of practices (Ramu *et al*., 2000). Even though farmers are keen to adopt the recommended package of practices, high cost of fertilizer inputs and availability of labour pose problem in adopting the soil health management (Ramu *et al*., 2000). At this juncture devising appropriate extension strategy needs attention in the transfer of technology (Swaminathan, 1994). Survey results also suggest that the scope for improving the soil health management through campaign to create awareness among the small growers.

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Table 1: Soil reaction of tea soils of small growers' farm

Parameter	pH range	Ooty	Kotagiri	Coonoor	Total
pH	< 4.50	40	49	27	116 (56.3%)
	4.51 – 5.00	17	22	8	47 (22.8%)
	5.01 – 5.50	3	13	4	20 (9.7%)
	5.51 – 6.50	0	7	6	13 (6.3%)
	6.51 – 7.30	1	3	1	5 (2.4%)
	>7.31	1	2	2	5 (2.4%)
	Total	62	96	48	206
Per cent distribution according to the sample in each category	<4.50	34.5	42.2	23.3	100
	4.51 – 5.00	36.2	46.8	17	100
	5.01 – 5.50	15	65	20	100
	5.51 – 6.50	0	53.8	46.2	100
	6.51 – 7.30	20	60	20	100
	>7.31	20	40	40	100
Relative distribution (%) within the region	<4.50	64.5	51	56.3	-
	4.51 – 5.00	27.4	22.9	16.7	-
	5.01 – 5.50	4.8	13.5	8.3	-
	5.51 – 6.50	0	7.3	12.5	-
	6.51 – 7.30	1.6	3.1	2.1	-
	>7.31	1.6	2.1	4.2	-
		100	100	100	

Table 2: Classification based on soil Electrical Conductivity

Parameter	Category	EC range	Ooty	Kotagiri	Coonoor	Total
EC	Normal	0.01-0.5	53	93	43	189 (91.7%)
	High	0.5-1.0	5	3	4	12 (5.8%)
	Very high	>1.0	4	0	1	5 (2.4%)
		Total	62	96	48	206
Per cent distribution according to the sample in each category	Normal	0.01-0.5	28	49.2	22.8	100
	High	0.5-1.0	41.7	25	33.3	100
	Very high	>1.0	80	0	20	100
Relative distribution (%) within the region	Normal	0.01-0.5	85.5	96.9	89.6	
	High	0.5-1.0	8.1	3.1	8.3	
	Very high	>1.0	6.5	0	2.1	
			100	100	100	

Table 3: Relative distribution of soil samples on the basis of soil organic matter content

Parameter	Category	Ooty	Kotagiri	Coonoor	Total
OM%	Low	42	56	36	134 (65.0%)
	Medium	19	36	10	65 (31.6%)
	High	1	4	2	7 (3.4%)
	Total	62	96	48	206
Per cent distribution according to the sample in each category	Low	31.3	41.8	26.9	100
	Medium	29.2	55.4	15.4	100
	High	14.3	57.1	28.6	100
Relative distribution (%) within the region	Low	67.7	58.3	75	
	Medium	30.6	37.5	20.8	
	High	1.6	4.2	4.2	
		100	100	100	

Table 4: Distribution pattern of analysed soils of various regions on the basis of soil organic carbon

Parameter	Category	Range	Ooty	Kotagiri	Coonoor	Total
OC%	Low	<3.0%	46	56	36	138 (67.0%)
	Medium	3.0-6.0%	16	37	10	63 (30.6%)
	High	>6.0%	0	3	2	5 (2.4%)
	Total		62	96	48	206
Per cent distribution according to the sample in each category	Low	<3.0%	33.3	40.6	26.1	100
	Medium	3.0-6.0%	25.4	58.7	15.9	100
	High	>6.0%	0.0	60.0	40.0	100
Relative distribution (%) within the region	Low	<3.0%	74.2	58.3	75.0	
	Medium	3.0-6.0%	25.8	38.6	20.8	
	High	>6.0%	0.0	3.1	4.2	
			100	100	100	

Table 5: Relative distribution of soil available nitrogen

Parameter	Category	Range	Ooty	Kotagiri	Coonoor	Total
Available N	Low	<600 ppm	42	74	42	158 (76.7%)
	Medium	600-1100 ppm	14	16	2	32 (15.5%)
	High	>1100 ppm	6	6	4	16 (7.8%)
		Total	62	96	48	206
Per cent distribution according to the sample in each category	Low	<600 ppm	26.6	46.8	26.6	100
	Medium	600-1100 ppm	43.8	50.0	6.2	100
	High	>1100 ppm	37.5	37.5	25.0	100
Relative distribution (%) within the region	Low	<600 ppm	67.7	77.1	87.5	
	Medium	600-1100 ppm	22.6	16.7	4.2	
	High	>1100 ppm	9.7	6.2	8.3	
			100	100	100	