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Soil Fertility Assessment in Different Villages of East Sikkim District

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ABSTRACT

Present study was carried during the year 2015 at seven different villages on 250 farmers field in East Sikkim District to analyze different soil chemical properties. Average soil organic carbon (SOC) was significantly higher in Tympyem village (1.39%). Soil was more acidic in sajong village (pH 4.98) compared to other village. Average mean value of pH was 5.42 (strongly acidic), SOC 1.29% (high), available nitrogen 313.20 kg/ha (medium), available phosphorus 17.30 kg/ha (medium), available potassium 455.25 kg/ha (high), available sulphur 21.45 kg/ha (medium). Average Boron content was higher in Samlik village (5.88 ppm), zinc content in Lossing (2.16), Iron content in Sajong (69.16 ppm), copper content in Tympyem (2.31 ppm) and manganese content in sajong (36.24 ppm).

1. Introduction

Sikkim enjoys a wide range of climate, physiographic, geology and vegetation that influence formation of different kinds of soils. Hills of Sikkim mainly consist of gneissose and half-schistose rocks, producing generally poor and shallow brown soils. The soil is coarse, with large concentrations of iron oxide; ranges from neutral to acidic making it lacking in mineral nutrients. Soils of Sikkim belong to 3 orders, 7 suborders, 12 great groups and 26 subgroups. It is observed that inceptisols are dominant (42.84%), followed by entisols and mollisols, occupying 42.52% and 14.64%, respectively. The area under acid soil having pH <5.5 of the state is 683.49 sq. km which is 53.0% of the geographic area (http://www.sikkimagrisnet.org). Soil testing started in one form or the other, as soon as man became interested in how plants grow. It is a very useful tool for quick determination of the fertility status of a soil to make fertilizer recommendations in that soil for various crops and cropping sequences as well as to make recommendations of soil amendments in problem soils. Thus, by testing soils one can know whether the area is acidic/ saline/ alkaline/ saline-alkali in nature as well as it is deficient in plant nutrients or not (Tisdale and Nelson 1975). As soil test levels increase for a particular nutrient, the expected crop yield response to additions of that nutrient decrease. Farmer's acceptance of soil testing is strongly dependent on the extent and severity to which nitrogen, phosphorus, potassium and pH are problems for crop production in the area, and the accuracy with which the tests can be used to predict crop responses and fertilizer needs (Das 2009). Soil testing includes collection of soil samples, preparation for processing of the collected samples, analysis of the collected processed sample, interpretation of the soil test values and crop-wise recommendation of amendments and organic fertilizers including its time and method of application. Soil testing provides a basis for fertilizer (organic/chemical) and soil amendments. The objective of this research paper was to evaluate different chemical properties of soil from different farmers field to assess soil fertility for soil health card which will give information both on macro and micro nutrients for organic input recommendation to the farmers.

2. Materials and Methods

Geo-reference soil samples were collected from farmers field of different villages namely; Tempyem, Sajong, Sajong-Rumtek, Rumtek, Lossing, Samlik and Namin villages (1150-1450 m above MSL) of East Sikkim District at a depth of 0–15 cm (plough layer).

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Sampling has been made from an area of 10 ha grid under rainfed condition. GPS and other general detailed information have also been collected from each and every farmer belonging to that grid area. For a single grid, soil sample has been drawn from 10 randomly selected sites of different farm holding and subsequently mixed as per standard procedure to obtain a representative composite sample of that particular grid. Brief description of village along with number of farmers and grid has been shown in Table 1. Samples were collected in polythene bags by following standard procedure, then dried in shade, ground, sieved through a 2-mm sieve and stored at room temperature (27±1 ^{o}C). Different physico-chemical properties were analysed with standard method. Organic carbon measured by using the Walkley and Black method (1965). Soil pH (1:2.5 H_2O) was measured according to Black (1965). Micronutrients (Zn, Fe, Cu, Mn) was analyzed by DTPA-$CaCl_2$-TEA extraction method (Lindsay and Norvell1978). Boron was analyzed hot water treatment (Gupta 1967). Sulphur was analyzed by $CaCl_2$-extracted (Williams and Streinbergs 1969). Available nitrogen by Kjeldahl method (Subbiah and Asija1956), available phosphorus by Bray's P-1 method (Bray and Kurtz 1945), available potassium by ammonium acetate method (Hanway and Heidel 1952).Based on the analysis of soil sample, Soil Health Card has been distributed to the 250 nos. of farmers on the occasion of World Soil Day on December 5, 2015.

Table 1. Details of farmers on the selected villages

Village	Number of farmers field	Number of grid per village (1 grid=10 ha)
Tempyem	38	8
Sajong	40	8
Sajong-Rumtek	47	10
Rumtek	47	8
Lossing	50	8
Samlik	16	3
Namin	11	2

3. Results and Discussion

Average pH and SOC values of different village of East Sikkim District has been presented in Table 2. Results showed that average SOC was significantly higher in Tympyem village (1.39%), followed by Rumtek, Namin, Lossing, Sajong-Rumtek, Samlik and Sajong accounting SOC values 1.21, 1.17, 1.06, 1.00, 0.96 and 0.86, respectively. Results also showed that soil was more acidic in Sajong village (4.98) as compared to other village. This may due to be low SOC value of that village as SOM increase buffering capacity of soil.

Table 2. Average pH and SOC value of different village of East Sikkim District

Name of village	pH	SOC (%)
Tempyem	5.39	1.39
Sajong	4.98	0.86
Sajong-Rumtek	5.34	1.00
Rumtek	5.38	1.21
Lossing	5.18	1.06
Samlik	5.67	0.96
Namin	5.87	1.17
LSD (*P=0.5*)	0.87	1.26

Average soil test report of 250 farmers of different village of East Sikkim District has been shown in table 3. Results showed that mean value of pH was 5.42 (strongly acidic), SOC 1.29% (high), available nitrogen 313.20 kg/ha (medium), available phosphorus 17.30 kg/ha (medium), available potassium 455.25 kg/ha (high), available sulphur 21.45 kg/ha (medium). Besides all the micronutrients were in sufficient range.

Table 3. Average soil test report of different villages in East Sikkim District

Parameters	Range	Mean	SD
pH	4.86-5.97	5.42	0.58
Organic Carbon	0.67-1.91	1.29	0.37
Available N (kg/ha)	210-416.4	313.20	27.6
Available P (kg/ha)	11.9-22.7	17.30	8.48
Available K (kg/ha)	416.3-494.2	455.25	8.67
Available S (kg/ha)	13.45-29.45	21.45	13.2
Available Zinc (ppm)	0.86-2.87	1.87	3.45
Available Boron (ppm)	3.46-6.23	4.85	2.37
Available Iron (ppm)	26.48-88.13	57.31	7.84
Available Manganese (ppm)	10.36-39.78	25.07	2.67
Available Copper (ppm)	0.59-3.02	1.81	5.67

Variation in primary and secondary nutrient among different village has been depicted in Figure 1. Results showed that available nitrogen content was higher in Tempyem village (390.0 kg/ha), available phosphorus in Rumtek village (21.3 kg/ha), available potassium in Rumtek (468.8) and available sulphur in Namin (27.34 kg/ha), respectively. Lowest nitrogen was found in Sajong village (307.1 kg/ha) which may due to be lower average pH value.

Variation in different micronutrients like Zn, Fe, Cu, Mn and B has been shown in Figure 2. Results showed that average B content was higher in Samlik village (5.88 ppm), average zinc content in Lossing (2.16), average Iron content in Sajong (69.16 ppm), average copper content in Tympyem (2.31 ppm), average manganese content in Sajong (36.24 ppm), respectively. But lowest average iron and manganese content was observed in Samlik village with value 27.85 and 27.11 ppm, respectively (critical limit of Fe is 4.5 mg/kg and Mn is 2.0 mg/kg). This may due to be slightly higher pH on that village. Lowest average zinc and coper was found in Sajong village with values 0.98 and 0.84 ppm (critical limit 0.6 mg/kg for Zn and 0.2 mg/kg for Cu).

Figure 1. Variation in primary and secondary nutrients among different villa

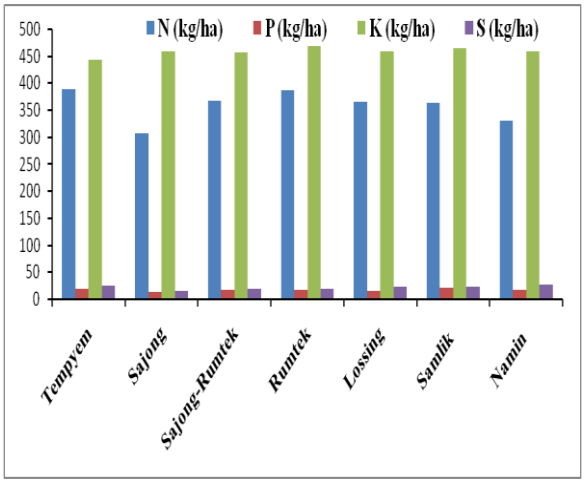
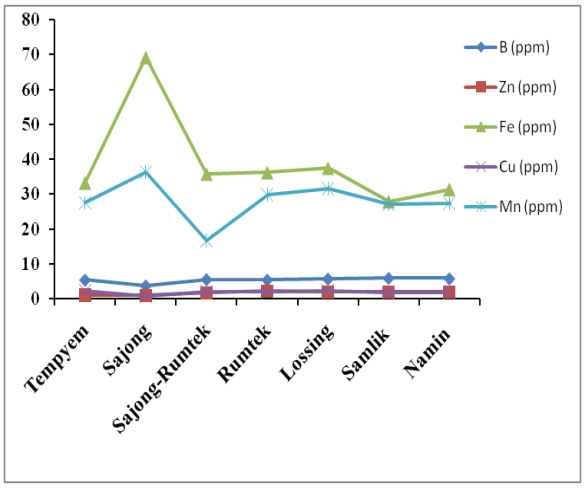


Figure 2. Variation in micronutrients among different villages



Conclusion

Soil testing helps to diagnose soil health by soil health card and evolve soil specific and crop specific solutions. Soil health card helps to identify problematic soils, their nutritional status, texture and structure. Based on the analysis, farmers are advised on soil fertility management through rational use of manure, fertilizers and amendments to make agriculture more productive and sustainable.

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