SOIL NUTRIENT STATUS OF CROP FIELDS IN TWO VILLAGES OF KOSI-WATERSHED, UTTARAKHAND

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Introduction

Soil is a vital component of the earth's biosphere; it helps not only in the production of food and fiber but also in the maintenance of quality of the environment at local, regional, and global scale (Glanz, 1995). It is an important medium for plant growth and also works as filter for maintaining water quality. It works as key component in the regulation of the global biogeochemical cycles and as an important medium for the disposal and degradation of wastes (Beare *et. al.*, 1997). Soil properties which affects the crop yield, include soil physical, chemical, and biological properties such as soil texture, depth of soil, infiltration, bulk density, water-holding capacity, soil organic matter, pH, electrical conductivity, microbial biomass, carbon and nitrogen, potentially mineralizable nitrogen, and soil respiration etc. This study presents preliminary information on the distribution and status of some soil properties of crop fields of two selected villages of Kosi watershed of Almora and Nainital district, Uttarakhand.

Study Site and Methodology

Soil sampling was carried out in the cultivated lands of Kantli (29°51'22.57 N, 79° 34'07.18 E; altitude 5780 ft) and Dhaniyakot (29°27'41.2 N, 79° 27'04.5 E; altitude 3494 ft) villages in Kosi watershed under Almora and Nainital districts of Uttarakhand state, respectively. Soil in Kantli village was Typic Udorthents associated with Dystric Eutrocherpts soil subgroup, whereas the soil in Dhaniyakot village was associated with Typic Dystrochrepts according to National Bureau of Soil Survey (1999). In both the villages crop fields are rainfed and FYM is used to replenish the soil fertility. Before sowing of rice crop in May 2014, seven soil cores from two different depths (1-15 cm and 15- 30 cm) were collected in Z shape using Augur from different subplots in the selected area. Samples from each individual plots were thoroughly mixed to make it composite, air dried and passed through a 2 mm sieve. Air dried samples were placed in plastic bags and stored at ambient temperature. Samples were analyzed for soil pH, moisture, organic carbon, potassium and water holding capacity.

Soil pH was measured in slurry of soil and deionized water in the ratio of 1:5. All the samples were stirred for 30 minutes and then allowed to stand for approximately 15 minutes before pH was measured using pre-calibrated digital pH meter (Jackson, 1958). Soil moisture was measured following ASTM D 2216 method by heating the 10 g air dried samples at 105°C for 24 hours. Water holding capacity was measured using Hilgard Cup method (Cassel and Neilson, 1986) and organic carbon was estimated using Walkley and Black (1934) method. Available potassium (K^+) was estimated following Jackson (1958) using flame photometer. The data were analyzed by Data analysis tool pack of Microsoft Excel- 2007 with a one-way analysis of variance (ANOVA) for knowing significance of variation of soil properties among different crop field sites within a village.

Results and Discussion

Average values of distribution of all the nutrients analyzed in the present study are given in Fig. 1(a-e). In Kantli village, pH of the agricultural soil was more towards acidic ranging from 5.95 to 6.87 in 0-15 cm depth and 4.88 to 7.2 in 15- 30 cm depth while in undisturbed control sites pH was estimated in the range 6.47 to 6.98. In Dhaniyakot village, pH of soil was found ranging from 6.99-7.0, while pH of control site was found to be varying between 6.43 and 6.68 in both the depths. Variation of soil pH within the village was not significant in both the villages ($p<0.05$).

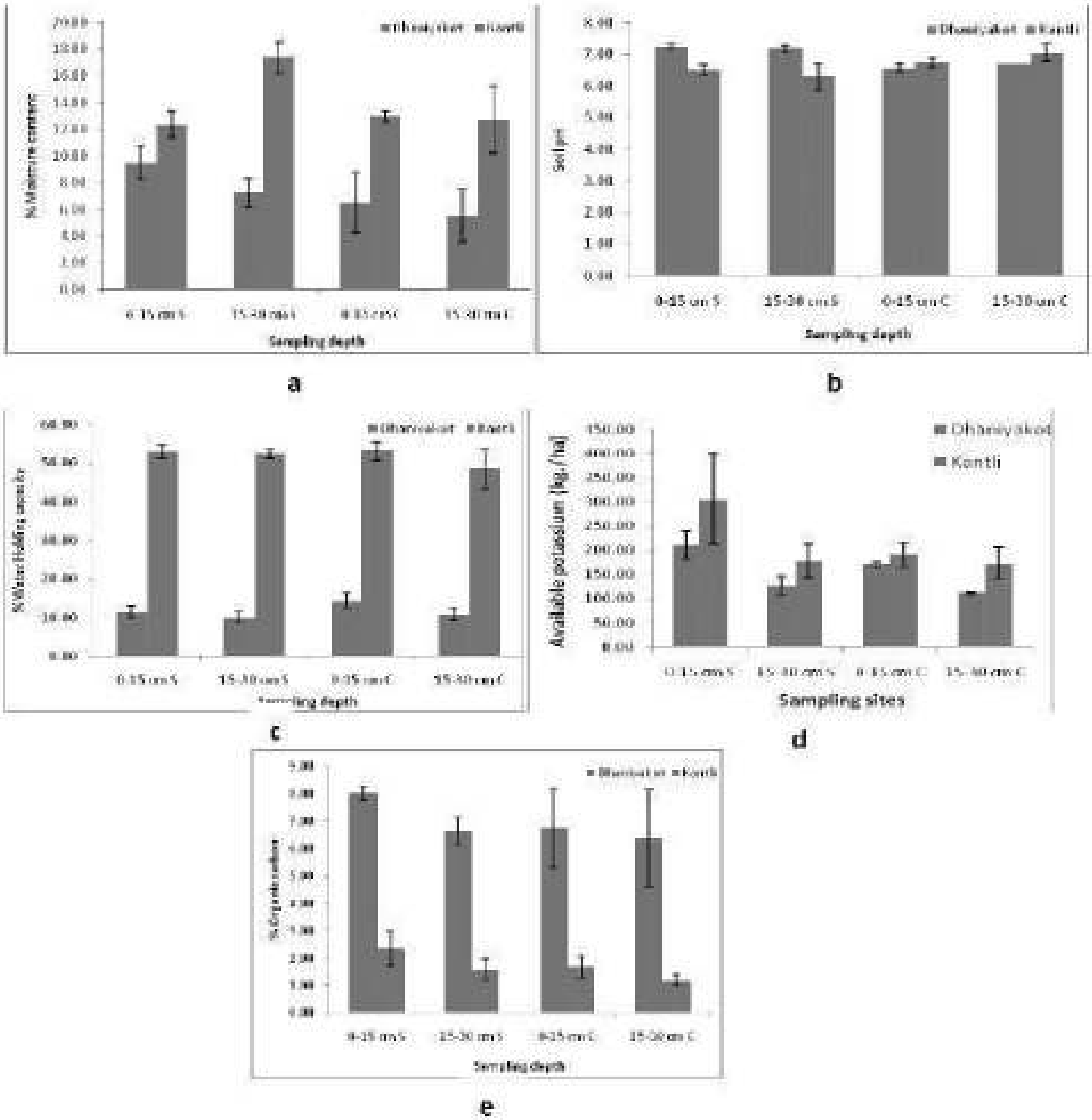

Fig. 1: Variation of soil nutrients in Dhaniyakot and Kantli village at two depths: (a) % Moisture content (b) pH (c) % Water Holding Capacity (d) Available Potassium (kg/ha) (e) % Organic carbon

Organic carbon (%) was observed higher in Dhaniyakot than Kantli village in-spite of having oak forest in nearby areas in Kantli village. In the top layer of soil (0-15 cm) in Dhaniyakot village, organic carbon was observed ranging from 4.68 to 6.53%, and OC was lower at 15- 30 cm depth (2.13- 6.00%) while in Kantli village, it was found ranging from 1.42 to 3.00 % in 0-15 cm depth and 0.66 to 2.24% in 15- 30 cm depth. Variation of SOC in Kantli village was significant while in Dhaniyakot village, it was not significant ($p<0.05$). In the control sites organic carbon (OC) was lesser than agricultural lands. In most of the sampling sites of Dhaniyakot village, OC was found in the medium range (4- 10%) while in Kantli village, OC was low (<4%) (range mentioned in Hill laboratories KB 10151 Assessing Soil Quality- the Organic Soil Profile). Decrease of OC in Kantli village may be due to the agricultural practices like removal of crop residue from the field after harvesting of earlier sown crop whereas in Dhaniyakot, it was found that farmers do not remove the crop residues from the crop fields and plough the field along with residues. Importance of crop residues for organic carbon management has been also reported elsewhere (Al-Kaisi and Yin, 2005).

Water holding capacity and moisture content was found higher in Kantli than in Dhaniyakot village. In Kantli, average soil moisture was 12.35% at 0-15 cm and 17.40% at 15-30 cm while in Dhaniyakot, average soil moisture was 9.52% at 0-15 cm and 7.25% at 15-30 cm. In the control sites, it was found ranging from 5.53 to 6.49% along the depth. In Kantli, average % WHC was observed 53.06% at 0-15 cm depth and 52.39% at 15-30 cm depth while in Dhaniyakot, WHC was 12.26% at 0-15 cm depth and 10.70% at 15-30 cm depth. At control sites of Kantli, average WHC values were found ranging from 48.65 to 53.22% along the depth and in Dhaniyakot, values were found ranging from 10.70 to 12.26% along the depth. Variation of both the soil WHC and soil moisture within the village was not significant ($p<0.05$). The higher value of soil moisture and WHC might also be due to oak forests, as higher amount of litter in oak forests influences the texture of soil that results in higher water retention capacity (Saxena and Singh, 1980; Woomer and Swift, 1994). But in case of Dhaniyakot having higher concentration of OC, yet the water holding capacity was found very low. This might be due to the sandy texture of soil as sandy soil is having small surface area and less pore volume (Foth, 1984), due to which it is prone to leaching and can retain less moisture.

Potassium (K^+) is an important nutrient for paddy crop. The concentration of K^+ was higher in Kantli village than that of Dhaniyakot village. In the upper soil layer (0-15 cm), potassium was found varying from 98.52-619.44 kg/ha in Kantli while in Dhaniyakot, it was found varying from 101.77-291.50 kg/ha. Variation of soil available potassium within the village was not significant ($p<0.05$) in both the villages. In most of the subplots, potassium was found under the medium level (113 to 280 kg/ha; Muhr *et al*., 1965). Availability of potassium for plants is greatly affected by soil moisture content as increase in soil moisture increases movement of K to plant roots and enhances its availability. Organic matter or OC particles can retain most of the positively charged ions in soil. However, as an exception; some potassium can leach through the organic soils because of the fact that the attraction between OC and K^+ is relatively weak. Loss of the nutrients can also be attributed to sandy texture of soil because the sand is not having any charge so sand particles cannot hold ions. It was observed that, though soil in Dhaniyakot village has relatively higher concentration of OC percentage yet it has lesser potassium content in soil, therefore to enhance the crop productivity potash may be added in soil.

References

Al-Kaisi MM & Yin X. 2005. Tillage and crop residue effects on soil carbon and carbon dioxide emission in Corn–Soybean rotations. *Journal of Environment Quality* 34: 437–445.

ASTM D. 2216- Standard test method for laboratory determination of water (Moisture) content of soil, rock, and soil-aggregate mixtures.

Beare MH, Cameron KC, Williams PH & Doscher C. 1997. Soil quality monitoring for sustainable agriculture, Proc. 50^{th} NZ plant protection Conf.: pp. 520-528.

Cassel DK& Nielsen DR. 1986. Field capacity and available water capacity. In: ALRH Miller and DR Keeney (Eds.), Methods of soil analysis part 2: Chemical and microbiological properties. Second edition. Agronomy Society of America, Madison, WI.

Cornell University Agronomy Fact Sheet 22: Soil CEC for Field Crops. URL: http://nmsp.css.cornell.edu/publications/factsheets.asp.

Foth H. 1984. Fundamentals of Soil Science. 7th edition. John Wiley and Sons. N.Y. pp.74-79.

Glanz JT. 1995. Saving our soil: Solutions for sustaining earth's vital resource. Johnson Books, Boulder, CO, USA.

Jackson ML. 1958. Soil Chemical Analysis. Prentice-Hall, Inc., Englewood Cliffs, NJ, pp. 214-221.

Muhr GR, Dutta NP & Subramanoey S. 1965. Soil Testing in India. USAID, New Delhi, India.

Saxena AK & Singh JS. 1980. Analysis of forest grassland vegetation in a part of Kumaun Himalaya. **Indian Journal of Range Management** 1: 13-32.

Woomer PL & Swift MJ. 1994. The biological management of tropical soil fertility. Wiley, Chichester, UK.

Walkley A & Black IA.1934. "An examination of the Degtijareff method for determining soil organic matter, and a proposed modification of the chromic soil titration method." *Soil Science* pp. 37-38.