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OBSERVATIONS ON CHANGES IN SOIL PHYSICO-CHEMICAL PROPERTIES AFTER FIRE TREATMENT IN THE GRAZING LAND OF GARHWAL HIMALAYA

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ABSTRACT

Observations were made on the effect of fire treatment on three experimental sites (an un-burnt protected, a burnt protected and a un-burn open grazing land). Immediately after burning there was an increase in soil temperature, soil moisture, soil texture soil pH, organic carbon percentage and available phosphorus. Fire reduced water holding capacity, total nitrogen and exchangeable potassium in soil particles.

Keywords:Fire, Soils, Physical, Chemical, Grazing land, Garhwal, Himalaya Control Plot (cp), Burnt Plot (bp) and Open Plot (op).

INTRODUCTION

Soil is one of the most important abiotic variables for growth and development of vegetation on any land. The composition and condition of humus determine the physical and chemical characters of soil. The arrangement of soil particles according to their size and shape is the most important single character affecting soil aeration, soil water condition, soil temperature, and thus the entire soil - plant relationship depends upon the physical properties of soil. In the present study following variables have been under taken. (1) Soil temperature (2) Soil moisture (3) Soil color (4) Soil Texture (5) Water holding capacity (6) Soil pH (7) Organic carbon (8) Total nitrogen (9) Available phosphorus and (10) Exchangeable potassium.

Effect of fire in grasslands has been studied by De Bano et al. (1977) who investigated the effect of fire on physical and chemical properties of Chapperal soils. Ramakrishanan and Toky (1981) studied the effect of slash and burning on soil erosion

in North- East India. Ghildiyal (1981) has given an account of some soils of Kumaun and Garhwal in relation of their chemical characteristics and erosion on steep slopes. Semwal (1990), Mehta (1990) and Bhandari (1995) have analysed the effects of fire on different physical and chemical properties of soils on montane and submontane forests and grazing lands of Garhwal Himalaya. In the present paper an effort has been made to explain the effects of surface fire on soil of grazing lands in terms of color, texture, temperature, water holding capacity, moisture, pH, organic carbon, total nitrogen, available phosphorus and exchangeable potassium from different depths.

Organic carbon, pH and available potassium in soil under the grass cover of Pauri Hills were discussed by Tiwari and Gupta (1982). Tiwari (1985) studied the physico-chemical characteristics of soils under different forests and grazing lands of Garhwal Himalaya in relation to fire. The short term effects on nutrient availability depend on the thermal effects of the fire on organic compounds, the rise in soil pH, and the microbial processing of organic matter Binkley et al. (1993).

Saharjo (1995) showed that even when there were changes in soil chemical properties following burning in the shifting cultivation area not far from one of the research site, the fire did not improve soil fertility.

MATERIALS AND METHODS

Experimental plots: For the present study, a grazing land of 2-ha area in the University Campus Chauras (30° 12' 15"- 30° 15' N. Lat. and 78° 50' E, long., 550 m ASL) was selected. Study plot was divided into three sub plots; two were unburnt and third was burnt. One from each (control and burnt) was further protected against grazing or other anthropogenic disturbances and the other remained open for grazing by animals. The burnt plot experienced intentional surface| ground fire on June 22, 1999.

Climate, Geology and Soil: Climatically, the valley exhibits submontane characters. Mean maximum temperature during the study period varied from January (18.8°C) to May (35.84°C), and minimum from December (6.45°C) to July (24.43°C). The relative humidity was maximum (85.50 %) in July and minimum (49.25 %) in April. The maximum rainfall (207.5mm) was observed in June and minimum (9.5mm) in December. The area is constituted by the meta sedimentaries of Kumaun super group with few linseed bodies of limestone and dolomite. Mostly the study area is dominated by phyllite. The study area is covered by terraces of river Alaknanda and is covered by mainly three rock types of the upper proteozoic to lower paleozoic ages (Valdiya, 1980).

term effect of fire on soil colour. The percentage of sand particles was more on burnt plot than on un-burnt plots. Sandy soils in Pine forests and grazing lands have been observed by Tiwari et al. (1985), Semwal (1990) and Bhandari (1995). In the present study it was observed that fire decreased the water holding capacity of soil than of the control treatment. This finding gets support from Singh et al. (1991) who reported that in burnt soil there is low water potential. Soil pH is a single property which identifies the chemical characters of soils. The acidic pH observed here gets support by Mehta (1990) who reported that there was no significant difference in soil pH between burnt and un-burnt plots. Identical results were also reported by Naidu and Srivasuki (1994) and Paliwal and Sundaravalli (2002).

The soil organic carbon was concentrated much more on upper horizon of soil profile on CP and BP in rainy, winter and spring season and reveres was true for summer season. There was no definite trend on OP.
During the study period, it was more in summer months on all the plots. Burning increased the organic carbon percentage in soil considerably followed by grazing and control plots, during summer months.

In the present study, the amount of soil nitrogen peaked in summer season on all the plots. This result is in accordance with Daubenmire (1968), Dryness et al. (1989) and Mehta (1990). On op, soil nitrogen was higher than on cp. Higher soil nitrogen on the grazed plot, might be due to the availability of the decomposing humus. In burning and grazing treatments increased the soil nitrogen (Mac Diarmid and Witkin 1972).The present results are identical to the Khanna (1991) and Naidu and Srivasuki (1994), they have also reported the decrease in nitrogen concentration in soil.

Available soil phosphorus was highest on bp than on cp. Identical results have been reported by Agarwal and Tiwari (1988), and Bhandari (1995). Increase in available phosphorus following fire has been reported by Ramkrishanan and Toky (1981). Ukpong (1998) reported that available phosphorus was higher in the rainy season than in dry seasons. Fire causes release of ash and heating of the soil which in turn increase phosphorus of the soil (Singh, 1994).

In the present study, the exchangeable potassium was higher on bp as compared to cp. The present results gets support from the studies of Bhandari (1995), Saharjo and Makhrwie (1998). They have reported that potassium is increased immediately after burning. Bhandari et al. (2000) observed higher potassium contents in Garhwal Himalayan grazing land after fire treatment. The chemical properties of soil are

determined by many biotic variables such as human interference and live stock population. Hence the primary productivity will also be influenced by these physical and chemical factors. Moisture regime of any ecosystem is the resultant of the interaction between climate and soil physicochemical properties.

The soil moisture percentage on burn plot was higher due to the presence of burn material on sand predominating soils. There was no significance difference in the soil colours on burnt and un-burnt plots, so there was no short term effect of fire on soil colour. The percentage of sand particles was more on burnt plot than un-burnt plot. Fire reduced the W.H.C. of soil than control treatment, so this finding that in burnt soil there is low water potential. Soil pH was acidic (6.5 to 6.8) and percentage of organic carbon (0.4 to 0.7) was increased after burn in soil. Soil nitrogen was higher on op than cp, higher soil nitrogen on grazed plot, might be due to the availability of the decomposing humus. Available phosphorus was highest on bp than on cp, fire causes release of ash and heating of the soil which in turn increase phosphorus of the soil (Singh, 1994). Exchangeable potassium was higher on op as compared to bp. It concluded that the effect of fire on soil chemical properties is negative.

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