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Introduction

In the last decades severe changes in land use occurred in tropical countries, due to increasing population and their demand for food resources. Forest land is rapidly converted into agriculture or pastureland which may cause significant changes in soil fertility. Land–use exerts significant effect on nutrient availability and may also influence secondary succession and biomass production (Lu *et al*., 2002). Nutrient cycling in agroforestry is in between natural forest ecosystems of the tropics and most of the agricultural systems with are ‘‘leaky’’ having higher nutrient losses. Research indicated that decline of soil organic matter may occur due to conversion of forest and grassland into agriculture (Ouattara *et al*., 2006). Tree growth is highly influenced by base cations (Ca, Mg, K, Na) concentration, cation exchange capacity, and concentrations of Al and Mn. Calcium and N are specifically important, as they are primary constituents of biomass and regulate cell function of many tree species. Base cations also help in alleviating the effects of Al toxicity in acid soil.

Materials and Methods

The field is located in Dharmshala District of Himachal Pradesh State, India. The experiment site is situated at 30° 6' 0" N, 73° 3' 0" E longitude, 1300 m elevation. The mean annual temperature ranges from 15-19° C and rainfall is 2500 to 3000 mm. According to the USDA Soil Taxonomy the soil is classified as Typic Hapludalf. The pH ranges from 5.3 to 5.8. Land use systems studied were (1) Natural forest of *Pinus roxburghii* (2) Grassland (3) Mango plantation (Horticulture) (4) Agriculture (monocropping of Paddy/wheat/maize) (5) Wasteland.
Collection of soil sample was done from four layers: 0-15 cm, 15–30 cm, 30-45 cm and 45-60 cm, in three replications. Soil samples were passed through a 2-mm sieve after air drying. A combined glass–calomel electrode was used to determine the pH of aqueous suspensions (1:2.5 soil: solution ratio). Electrical conductivity (dS m^{-1}) was measured by conductivity bridge (Richards, 1954) in 1:2 soil water suspensions. Soil organic carbon (OC) was determined by wet digestion method (Walkley and Black 1934). Available nitrogen (N) and phosphorus were measured by the alkaline permanganate method (Subbiah and Asija, 1956) and Bray II method (Bray and Kurtz, 1945), respectively. Cation exchange capacity (CEC) was calculated following method of Jackson (1974). 1M NH_4OAc (pH 7.0) was used to extract exchangeable Ca, K and Mg. Potassium content was determined by flame photometer.

Results and Discussion

Significant effect of land–use on soil pH was found (5.22 in forest and 5.72 in grassland), however, variation in soil pH with respect to depth was non-significant. OC content was higher in surface layer of forest landuse (3.01%) followed by grassland (2.16%) and least in deeper soil layers of agriculture (0.36%). As a general trend OC decreased with increase in the depth of soil. Cation exchange capacity did not vary significantly with depth. It was higher in grassland (15.81 c mol kg^{-1}) followed by forest (15.20 c mol kg^{-1}) and least in wasteland (13.01 c mol kg^{-}). Johnson (2002) also found high CEC in forest soils with high OC content. Highest N content was found under forest (699, 654, 623 and 597 kg/ha, at 0-15, 15-30, 30-45 and 45-60 cm depth, respectively), followed by grassland, horticulture and agriculture and least under wasteland. Nitrogen content decreased significantly with soil depth. A similar trend was found in case of available phosphorus and potassium also, although the depth effect was non significant. Exchangeable nutrient cations were significantly influenced by land use (Table 3). Exchangeable Ca was highest (0.801 c mol kg^{-1}) in grassland at 0-15 cm depth and least in wasteland (0.602 c mol kg^{-1}) at 45-60 cm depth. The Mg content was highest (0.402 c mol kg^{-1}) in grassland at 15-30 cm and least (0.201 c mol kg^{-1}) in horticulture at 45-60 cm soil layer. Exchangeable K varied from 0.231 c mol kg^{-1} in forest to 0.081 c mol kg^{-1} in wasteland. Exchangeable Al varied from 1.89 c mol kg^{-1} in surface soil of forest to 1.23 c mol kg^{-1} in horticulture at 45-60 cm depth. Similar results had been reported for Ca, Mg and Na, by Sharma *et al*., (2009).

Conclusion

It is evident from the study that high cation exchange capacity of grassland soil leads to higher exchangeable nutrients and better soil fertility.

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