Journal of Biodiversity and Ecological Sciences
(JBES©)
Vol. 4, Issue 3
ISSN: 2008-9287
Summer 2014

Original Article

Effects of Deforestation on the Edaphic Features and Phytodiversity of Selected Plants of Shangus Forests, South Kashmir (Jammu & Kashmir)

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ABSTRACT

The results of soil characterises showed pH acidic to neutral in range (6.713, summer to 6.933autumn) at forest site and highly acidic at deforested site (5.18,summer to 5.596,autumn) season. Moisture content in soil at both sites varied between 20.213%, summer to 20.503%, autumn at protected site and 15.226%, summer to 15.576%, autumn season at deforested site. Organic carbon depicted higher trend in summer season at forest site (2.873 %,) and low trend at deforested site in autumn season (2.30%). Forest site attributed high amount of organic matter (5.0633, summer) compare to deforested site (3.66%, autumn). Total nitrogen at both sites showed significant change with maximum nitrogen observed at forest site (0.119%) and minimum at deforested site (0.049% autumn).Calcium contents at two sites found to be significantly similar (5.42meq/100g, summer and 5.166meq/100g, autumn) for forest site and (4.72 meq/100g, summer and 4.41 meq/100g, autumn) at deforested site. Magnesium content in soil at forest site was significantly higher (4.543 meq/100g,) followed by low trend at deforested site (and 3.41 meq/100g, autumn). Moisture content in soil at forest site and deforested site depicted a little variation (20.213%, summer and 20.503%, autumn) and (15.226%, summer and 15.576%, autumn). Phytodiversity estimation showed higher trend at forest site (Shannon index=0.812, dominance Index=0.999 and evenness Index=0.417) and lower trend at deforested site (Shannon Index=0.779, dominance Index=0.606 and evenness Index=0.400). Highly dominant species at forest site include *Datura stramonium* (IVI=49.88), *Erigeron Canadensis* (IVI=46.99) and *Rumex sp*. (IVI=59.45), However, at deforested site dominance was shown higher by *Erigeron Canadensis* (IVI=47.14), *Rumex sp*. (IVI=46.51), *Trifolium pratens* (IVI=61.13) and *Datura stramonium* (IVI=45.72). Abundance to Frequency ratio (A/F) showed contiguous trend in species distribution pattern. However, only two species depicted random and regular distribution of species at forest site while at deforested site, three species fall in contiguous as well as random distribution and only one species showed regular distribution. Comparative assessment of the results showed forest site high in soil nutrients and phytodiversity compared to deforested site.

KEYWORDS: Diversity, Seasons, Soil, Forest.

INTRODUCTION

The unprecedented increase in human population during recent years has brought excessive land under agriculture, housing, roads, etc., and increased biotic pressure on native forests (Joshi and Kumar, 2008). The combination of rapid urban and industrial growth, extensive deforestation and unsustainable agriculture, including inadequate soil conservation, cultivation of steep slopes and overgrazing, has had a devastating impact on land resources (UNEP, 2000). Fragments can be bombarded with diaspores of exotic or weedy species that may be incorporated into remaining plant community, sometimes eliminating species confined to forest interiors (Janzen 1986; Tabarelli et al. 1999). Rates of mortality and canopy gap formation also tend to increase near edges after fragmentation (Laurance et al. 1998).

Globally, concerns are raised over the rapid loss of biodiversity in all its forms and at all the levels. Habitat destruction is the chief cause of the biodiversity loss. Habitats can either disappear completely or they may become degraded and/or fragmented, both causing serious impact on species as well as ecosystem processes. Regionally, species introductions and altered disturbances rates may favour increased local diversity, but habitat loss or modification, outbreaks of introduced or native species, and management of exploitable systems tend to decrease species richness and heterogeneity (Lubchenco et al. 1991). Environmental heterogeneity has long been recognized as an important factor maintaining biological diversity

(Huston 1994). The broken canopy creates an internal mosaic involving spatial gradients of light, soil moisture, soil organic matter, temperature and effective rainfall (Breashears et al. 1997) which ultimately govern the overall diversity of vascular flora. At the fine scale, comparatively well-developed herbaceous vegetation interferes with the regeneration of trees, and has higher species number and diversity per unit area as compared to trees, therefore, it regulates all vascular richness. Disturbance leads to deforestation, forest fragmentation and degradation and subsequent exotic species invasion, all of which adversely affect plant diversity. The alteration of land use pattern has resulted in fragmentation of habitats, ecosystems and landscapes in most parts of the world. Habitat fragmentation is a leading cause of biodiversity loss (Singh 2002). The herbaceous layer is also potentially quite sensitive to soil fertility and site conditions (Siccama et al., 1970; Peterson and Rolfe, 1982). Consequently, the herbaceous layer has been used as an indicator of general edaphic factors and forest site quality (Pregitzer and Barnes, 1982; Strong et al., 1991; Host and Pregitzer, 1992; Barnes et al., 1998; Dibble et al., 1999).Present study was conducted to analyse the impact of deforestation on edaphic features and phytodiversity in two sites of south Kashmir.

MATERIAL AND METHODS

SOIL ANALYSIS

Composite soil samples (0 to 30 cm depth) were collected using a soil auger at two selected sites. The collected samples were homogenized by hand mixing and sieved through a 2 mm mesh to remove large fresh plant material (root/shoot) and pebbles. Finally, the samples were air dried for further analysis (Jackson, 1967). The samples were analyzed for determination of soil temperature (Gliessman, 2000), moisture content (Michael, 1984), organic carbon (Walkey and Black's rapid titration method: (Walkey and Black, 1934) and total nitrogen by Kjeldahl method (Piper, 1966). pH was assessed by a digital pH meter (model Delux-101E) after a mixture with distilled water following this ratio 1:2.5 soil: water.

VEGETATION ANALYSIS

To study the community composition and other phytosociological characteristics of the herbaceous vegetation at two selected sites, systematic field surveys were conducted during two seasons Summer (June to Aug.) and Autumn (Sept. to Nov.). Phytosociological attributes of plant species were studied by randomly laying 16 quadrats of $1\times1m^2$ at each site (Rajvanshi et al., 1987; Sharma et al., 1983). Specimens of each plant species were collected per site and identified using standard taxonomic procedures.

DATA ANALYSIS

The vegetational data was quantitatively analyzed for density,frequency and abundance according to the methodology described by Curtis and McIntosh (1950). Relative values of these parameters were calculated following Phillips (1959) and were summed up to get importance value index (IVI) (Curtis, 1959). The diversity index (H') was computed by using Shannon-Wiener Index (Shannon-Weiner, 1963). Concentration of dominance was calculated following the formula given by Simpson (1949). Evenness index was computed according to Pielou (1966).

RESULTS

PHYSICO-CHEMICAL ATTRIBUTES OF SOIL

The different parameters of soil are presented in figure (1-8). Moisture content in soil at both sites depicted a little variation 20.213%, summer to 20.503%, autumn at protected site and 15.226%, summer to 15.576%, autumn season at deforested site. The pH was acidic to neutral in range (6.713, summer and 6.933, autumn) at forest site while at deforested site it showed acidic nature(5.180, summer and 5.596, autumn season). Soil organic carbon depicted high trend in summer season, 2.873% at protected site and 2.65% at deforested sites respectively followed by a similar tend in autumn season at both sites (protected site, 2.536% deforested site; 2.30%). Forest site reported highest amount of organic matter (5.063%, summer and 4.366%, autumn) compare to deforested site (4.353%, summer and 3.783%, autumn). Total nitrogen at both sites showed significant change as maximum nitrogen was observed at forest site (0.119%, summer and 0.105%, autumn) and minimum at deforested site (0.078 %, summer and 0.049%, autumn). Calcium contents at two sites found to be significantly similar (5.42meq/100g, summer and 5.166meq/100g, autumn) for forest site and (4.72 meq/100g, summer and 4.41 meq/100g, autumn) at deforested site. Magnesium content in soil at forest site was significantly higher (4.543 meq/100g, summer and 4.28 meq/100g. autumn) compared to deforested site (3.713 meq/100g, summer and 3.41 meq/100g, autumn). Soil temperature was recorded maximum at deforested site in summer season (20.93^0C and 20.423^0C) compared to forest site in autumn season (19.966^0C and 19.596^0C).

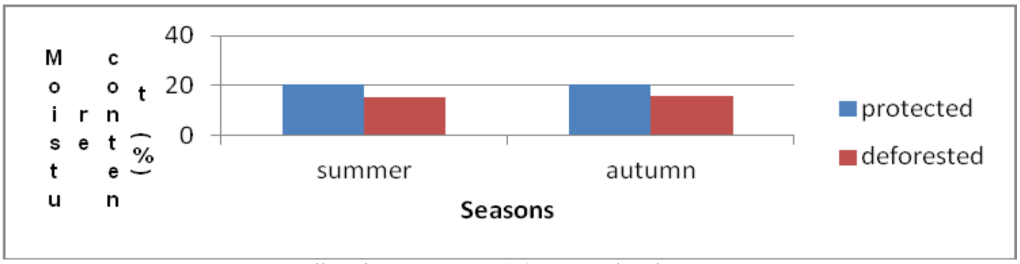

Fig.1. Soil moisture content (%) at two sites in two seasons

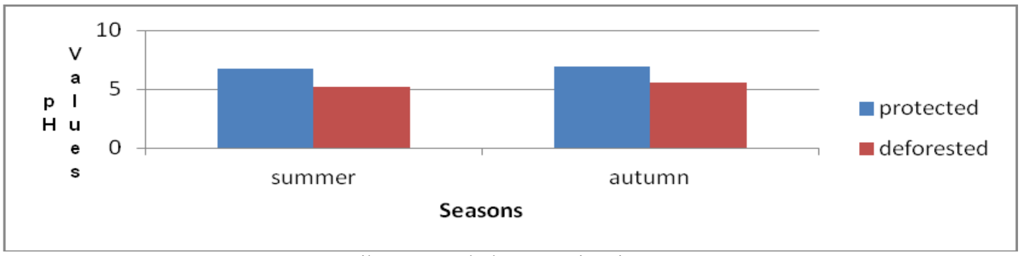

Fig. 2. Soil pH recorded at two sites in two seasons

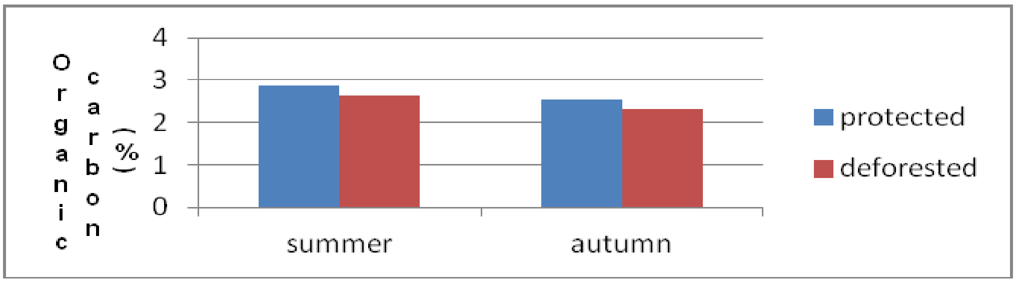

Fig.3. Soil organic carbon (%) recorded at two sites in two seasons

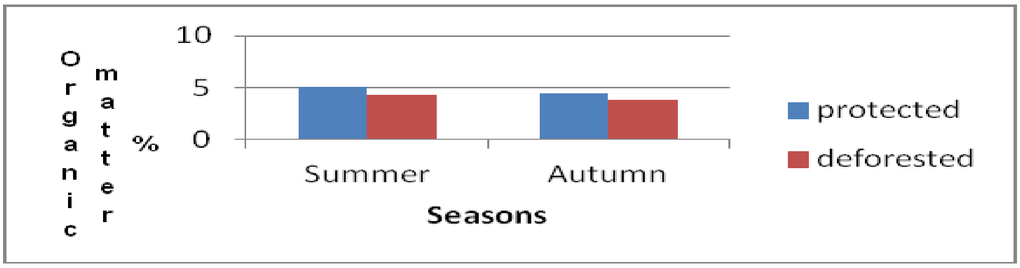

Fig. 4. Soil organic matter content (%) recorded at two sites in two seasons

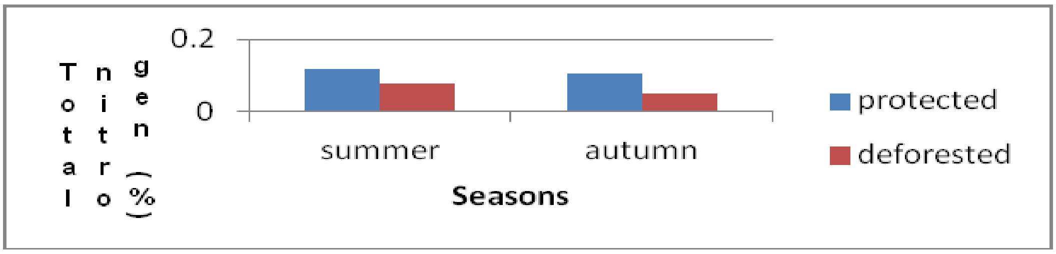

Fig. 5. Total nitrogen (%) recorded at two sites in two seasons

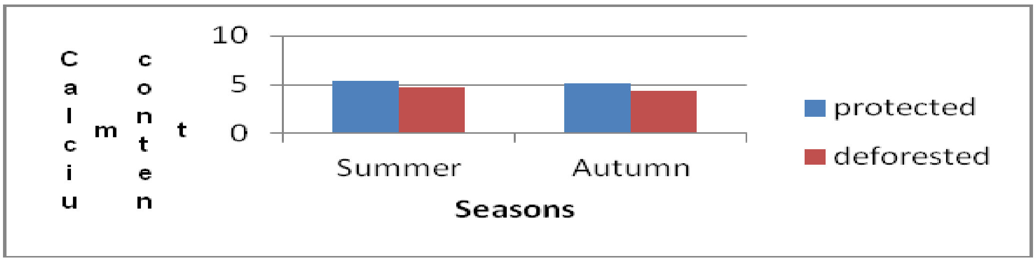

Fig. 6. Calcium content (meq/100g) recorded at two sites in two seasons

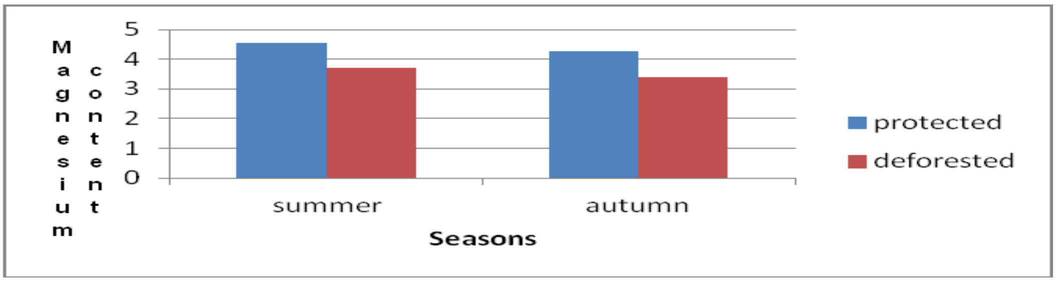

Fig. 7. Magnesium content (meq/100g) recorded at two sites in two seasons

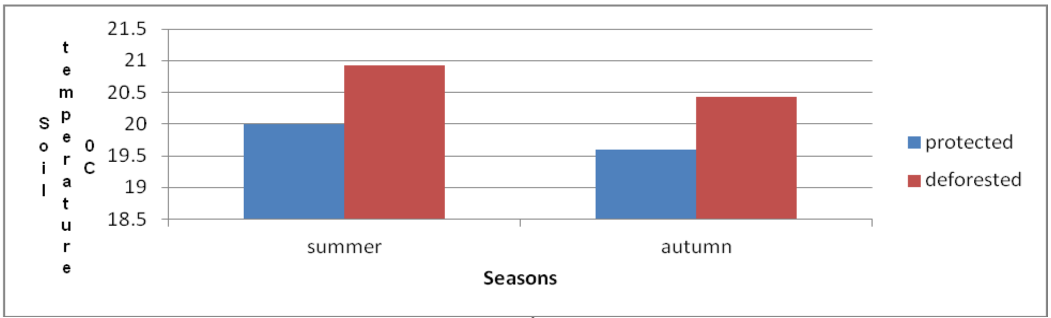

Fig. 8. Soil temperature (^{0}C) recorded at two sites

VEGETATION ATTRIBUTES

The vegetation parameters are depicted at Figure (9-13).Different diversity indices estimate showed high trend at forest site (Shannon index=0.812, dominance Index=0.999 and evenness Index=0.417) and lower trend at deforested site (Shannon Index=0.779, dominance Index=0.606 and evenness Index=0.400). Highly dominant species based Importance value Index (IVI) at forest site include *Rumex sp.* (IVI=59.447), *Cynodon dactylon* (IVI=36.580), *Datura stramonium* (IVI=49.88), *Erigeron Canadensis* (IVI=46.997), *Taraxacum officinale* (IVI=41.386), *Trifolium pratense* (IVI=35.774) and *Trifollium repens* (IVI=35.374). However, at deforested site *Cynodon dactylon* (IVI=32.553), *Datura stramonium* (IVI=45.72), *Erigeron Canadensis* (IVI=47.149), *Rumex sp.* (IVI=46.510), *Taraxacum officinale* (IVI=31.558), *Trifolium pratens* (IVI=61.127) and *Rumex sp.* (IVI=46.51) were highly dominated. Frequently occurred species with 100% frequency at forest site were *Rumex* sp. and *Trifolium repens* followed by rest of species in 80% frequency category. At deforested site a variable variation (20% to 30%) in frequency occurrence was observed among species with *Trifolium pratens* (50%) as frequently occurred species. Density at protected forest site was recorded highest by *Rumex sp.* (6.8/m^2), *Datura stramonium*(6.5/m^2) and *Erigeron Canadensis (*6.0/m^2). Rest of the species in density at this site varied between (1.8 to 5/m^2). At deforested site *Trifolium pratens* (2.10/m^2) and *Erigeron Canadensis* (1.59/m^2) showed high density comparatively to other species. Abundance to Frequency ratio (A/F) at forest site showed contiguous trend in species distribution pattern. However, only two species depicted random and regular distribution (*Trifolium pratens*=random; *Trifolium repens*=regular) at this site. At deforested site, maximum species reported contiguous species distribution followed by random distribution and no species show regular appearance at this site.

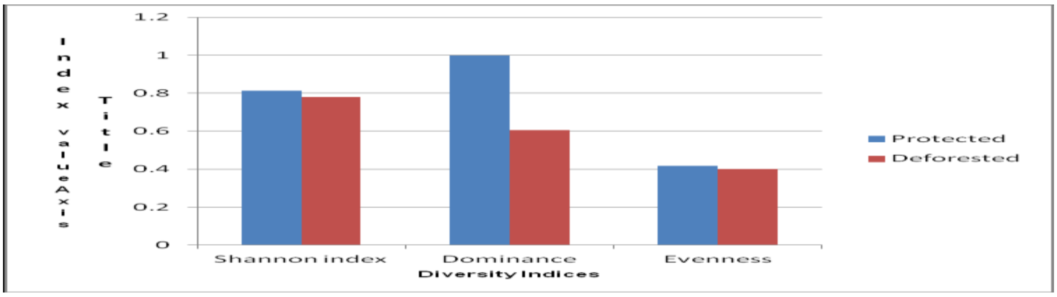

Fig.9. Diversity estimation of plants at two sites using different diversity indices

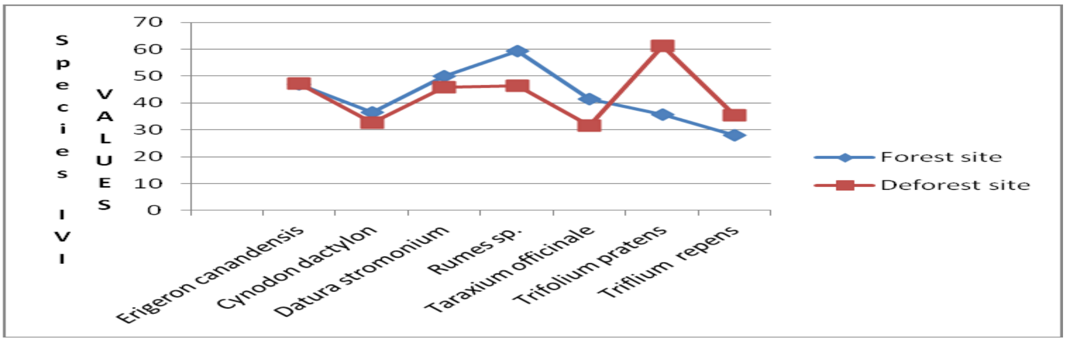

Fig.10. Species showing Importance value index at two sites

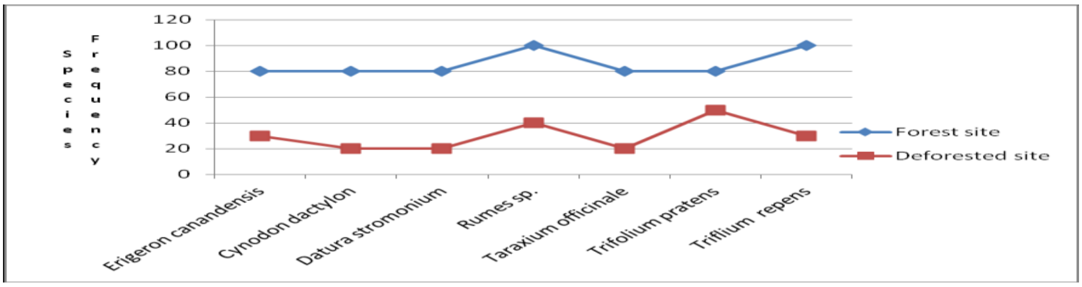

Fig.11. % Frequency occurrence of species recorded at two sites

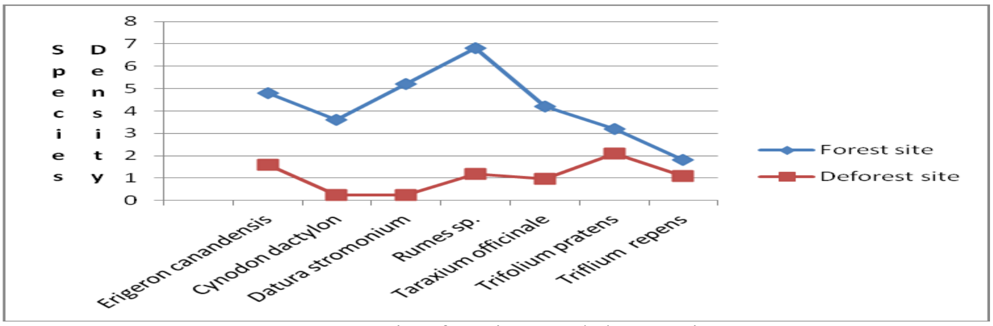

Fig.12. Density of species recorded at two sites

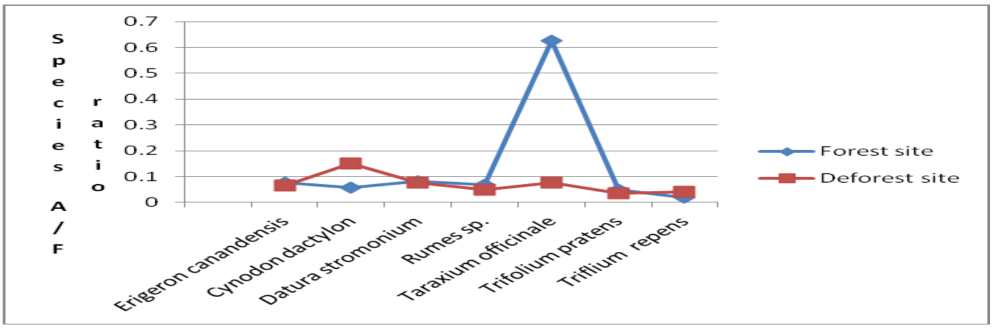

Fig.13. Abundance/Frequency ratio (%) of species recorded at two sites

DISCUSSION

SOIL PARAMETERS

Soil pH influences the availability of nutrient and it is a good indicator of forest fertility (Black, 1968). The pH has acidic value at deforested site (5.18 and 5.595) to nearly neutral at forest site (6.713 and 6.933). The acidic to nearly neutral pH values has also been reported in forest sites by Kala, 2005; Shameem et al., 2011. Such natural changes in pH values due to deforestation have earlier reported by Kala 2005, Shameem et al., 2011. Boyle (1975) and Mroz et al. (1985) mentioned that total tree harvesting may have several effects on forest soil including nutrient removal in the harvested material, increased erosion rates and/or percolation losses of nutrients and, also soil compaction. Moisture content in soil at both sites showed a variation of 20.213%, summer to 20.503%, autumn at forest site and 15.226%, summer to 15.576%, autumn at deforested site. Das et al. (1980) observed that the nature and content of organic debris returned to the forest floor varying with vegetation affecting the physical-chemical properties of the soil from direct impact of rain drops, there by controlling erosion on slopes and increases the moisture status of soil. The observations recorded in the present study are in accordance to the early study of Shameem et al., 2011. Organic carbon showed high trend in summer season at both sites (forest site, 2.873%; deforest site, 2.536%). Decreasing soil organic matter and aggregate size, increasing soil bulk density changes the basic status of the soil were few outcomes of the deforestation. Total nitrogen depicted significant change as forest site showed high trend (0.119% and 0.105%) compared to deforested site (0.078% and 0.049%). The possible reason for higher organic matter and nitrogen content at forest site is due to thick forest vegetation, higher moisture content and low decomposition rate (Borthakur, 1992). Supported study conducted by Patrick and Smith (1975) revealed that total tree harvesting caused the nutrient including nitrogen to be removed up to three times compared to conventional lodging. The high amount of humus and total nitrogen present in forest site could be explained by higher amount of available organic material at this site (Shourkaie et al., 2007). Forest site attributed high amount of organic matter (5.0633, summer) compare to deforested site (3.66%, autumn). This is due to high amount of litter addition to the site and also because of tree cover. Similar observation in support of present study has been reported by Shameem et al. 2011; Kharkwal and Rawat, 2010. The magnesium content in soil was recorded maximum at forest site (4.543 and 4.28meq/100g) compared to deforested site (3.713 and 3.41meq/100g). These observations are in accordance to the study carried out by Hajabbasi, 1997. However, calcium contents of soil at two sites were significantly similar in observation in accordance to the study conducted by Hajabbasi, 1997. Deforested site showed maximum soil temperature (20.93^{0}C and 20.423^{0}C) compared to forest site (19.966^{0}C and 19.596^{0}C).Vegetation removal can elevate nutrient availability (Davis and Pelsor, 2001), soil temperature and correspondingly increase mineralization rates (Gurlevik et al., 2004). Generally high soil temperature is recorded in areas where soil surface is not covered by vegetation have been reported in earlier studies (Shameem, et al., 2011: Kuhnelt, 1970). Investigators have speculated that potential impacts of intensive deforestation would be more severe on sites of poorer quality (Jurgensen et al., 1979). On the other hand, Rauscher (1980) reported that nutrient depletion might be greater in well rather than poor structured soils. An increase in exposed soil coinciding with a reduction in vegetation cover can be perceived as an indicator of ecosystem dysfunction (Tongway and Ludwig, 1997). Lower vegetation cover reduces the efficienny with which resources can be captured and utilized such as water, organic material and nutrients (Blackburn, 1986; Humberto et al., 1996; Simons and Allsopp, 2007).

VEGETATION ATTRIBUTES

Biodiversity has attracted world attention because of the growing awareness of its importance on the one hand and the anticipated massive depletion on the other side (Singh 2002).

Different diversity indices estimated showed high trend of Shannon index=0.812, dominance Index=0.999 and evenness Index=0.417) at forest site and lower trend at deforested site (Shannon Index=0.779, dominance Index=0.606 and evenness Index=0.400). Such diversity trends in current study habitats were in comparison to the early study conducted by Shameem et al. 2010; 2011; Joshi and Kumar, 2008. Substantially higher herbaceous species diversity in protected forest patches compared to degraded plots has been well also reported by Louhaichi et al. 2009; Milchunas and Lauenroth 1993 and Osem, 2002. The lower diversity trends at forest site in autumn site could be due to lower rate of evolution and diversification of communities (Fischer, 1960; Simpson, 1964) and severity in the environment (Connel and Oris, 1964). Although Magurran (1988) considered the Shannon index to be influenced more by richness than by evenness, theoretically the influence of richness and evenness on diversity may vary in importance (e.g. high diversity can arise from moderate evenness with high richness, or from moderate richness with high evenness). The moderate level of disturbance somewhat increased the herb species richness, but severe disturbances (totally deforested site) caused a drastic reduction in plant diversity (Joshi and Kumar, 2008; Shameem et al., 2010). Importance value Index (IVI) may indicate the role of different plant communities (Ning et al., 2002). It showed complete variation between forest site and deforested site with high trend in IVI species value recorded at forest site. Changes in the vegetation can be expected to be particularly pronounced in forests, which represent not only the most phytodiverse terrestrial ecosystems (Kirilenko and Sedjo, 2007) but also gets affected due to drastic changes in their microclimatic conditions especially in small forest fragments (Rosenzweig, 1992).

However, a strong link between herbaceous plant diversity and soil parameters associated with the availability of nutrients has indeed been reported in previous studies (Ramovs and Roberts, 2003; Chust et al., 2006; Marks et al., 2008., Shameem et al.,2011). Nonetheless, it could also be argued that the observed patterns in herbaceous plant diversity represents a state of transition within these plant communities, with different herbaceous species adapting to changes in the climatic conditions at different rates (Watson, 1980; Shmida and Wilson, 1985; Keeley et al., 2005). In the present study a reduction in species cover has ban observed in deforested site in comparison to forest site during two seasons.

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