Catena 171 (2018) 125–135

Contents lists available at ScienceDirect

Catena

journal homepage: www.elsevier.com/locate/catena

Effect of vegetation type and season on microbial biomass carbon in Central Himalayan forest soils, India

Kiran Bargali[a], Vijyeta Manral[a,*], Kirtika Padalia[a], S.S. Bargali[a], V.P. Upadhyay[b]

[a] Department of Botany, DSB Campus, Kumaun University, Nainital 263002, India
[b] Ministry of Environment, Forest and Climate Change, North Eastern Regional Office, Shillong 793021, India

ARTICLE INFO

Keywords:
Microbial
Soil carbon
Soil characteristics
Soil fertility
Decomposition
Vegetation cover

ABSTRACT

Soil microbial biomass is an important component of soil organic matter constituting from 2 to 5% of the soil organic carbon and play a significant role in the cycling of nutrients and overall organic matter dynamics. The present study assessed the effects of three forest types (Banj-oak forest, Chir-pine forest and Mixed oak-pine forest) on the soil physico-chemical properties and microbial biomass Carbon in Central Himalaya, India. The soil microbial biomass carbon was determined by chloroform fumigation extraction method. In the 2 year of study period, the soil microbial biomass carbon (C_{mic}) was significantly higher in Mixed oak-pine forest (681 ± 1.81–763 ± 1.82 μg g^{-1}) than in the Banj-oak (518 ± 1.50–576 ± 1.73 μg g^{-1}) and Chir-pine forest (418 ± 1.42–507 ± 2.05 μg g^{-1}). Though insignificant, all the forest types showed distinct seasonal variations in microbial biomass carbon with a minimum value in winter season and maximum value in rainy season. The soil microbial quotients (C_{mic} to C_{org}) were higher in Chir-pine (2.52–4.18) and Banj-oak forest (2.26–4.02) than those reported in Mixed oak-pine forest (1.44–2.24). These results indicate that Mixed oak-pine forest is better in sustaining the soil microbial biomass and soil nutrients than Banj-oak and Chir-pine forest. It recommends that nutrients rich Mixed oak-pine forest should be preferred as a forest management practice to promote microbial diversity, their activities and soil quality enhancement in Central Himalayan forests.

1. Introduction

The soil microorganisms participate in the cyclic process of soil elements and play an important role in the decomposition and conversion of organic matter and supply (Aguilera et al., 1999; Ekblad and Nordgren, 2002). The soil microbial biomass represents a major labile pool of nutrients in the soil containing 1–5% of the soil organic matter and a major labile pool of nutrients in the soil (Jenkinson and Ladd, 1981; Sun et al., 2010). It plays an important role in the retention and release of nutrients and energy and has a turnover time of less than a year and can react quickly to conditions of nutrients, moisture, temperature and the type and amount of soil organic matter (Paul, 1984) thus, can be used as an indicator of the soil fertility in soil ecological studies (Yadav, 2012) and sustainable environmental management.

Vegetation cover influence the soil fertility and composition of microbial community, which in turn affect the soil microbial biomass and microbial efficiency in carbon utilization (Bargali et al., 1993b; Bargali, 1996). The microbial processes of carbon and nitrogen cycles are affected by forest vegetation due to the differences in quality and quantity of litters, root exudates and the soil properties (Kara and Bolat, 2008; Bargali et al., 2015). Soil microbial biomass and community composition have been shown to be sensitive indicators of changes in nutrient types (Franzluebbers et al., 1999; Haney et al., 2001; Spohn et al., 2016), flora (Borga et al., 1994) and climate change (Zogg et al., 1997). Climatic conditions have a direct effect on microbial communities through the soil moisture and temperature (Chattopadhyay et al., 2012; Ullah et al., 2012; Díaz-Raviña et al., 1995), but they may also have an indirect effect through interactions with other factors such as vegetation, topography and landscape (Myers et al., 2001). Changes in microbial biomass carbon contents in responses to vegetation types are related to the plant diversity, the proportion of easily decomposable organic compounds, root density, microclimate and the soil structure (Moore et al., 2000).

Banj oak (*Quercus leucotrichophora A. Camus*) and Chir-pine (*Pinus roxburghii* Sarg.) are two dominant forest forming species in Indian Central Himalayan region. Central Himalayan ecosystems are subjected to a marked seasonality (Singh and Singh, 1992). Soil microbial biomass carbon plays an important role in understanding soil carbon cycle, soil carbon balance and chemical and biochemical characteristics of the soil. Information on soil microbial biomass carbon in different forest

* Corresponding author.
E-mail address: vijyetamanral@gmail.com (V. Manral).

https://doi.org/10.1016/j.catena.2018.07.001
Received 9 October 2017; Received in revised form 23 June 2018; Accepted 1 July 2018
0341-8162/ © 2018 Elsevier B.V. All rights reserved.

ecosystems have been reported by several workers (Srivastava and Singh, 1991; Arunachalam et al., 1996; Devi and Yadava, 2006; Patel et al., 2010) but information on seasonal changes in the microbial biomass carbon in Central Himalayan forest ecosystem is limited. In this study, the physico-chemical properties and soil microbial biomass carbon were measured and compared in three forest types (Banj-oak, Chir-pine and Mixed oak-pine) in Central Himalaya, India. The objectives of this study were to investigate: (i) how selected Central Himalayan forests differ in soil microbial biomass carbon and soil characteristics and (ii) how soil microbial biomass carbon varies seasonally and annually for the three Central Himalayan forests.

2. Materials and methods

2.1. Study area

This study was conducted in the Central Himalayan region near Nainital town of Uttarakhand state of India (Fig. 1). Three forest types viz., Banj-oak (*Quercus leucotrichophora A. Camus*), Chir-pine (*Pinus roxburghii* Sarg.) and Mixed oak-pine forests were selected between 800 and 2000 m altitude above mean sea level (29°19′–29°28′ N latitude and 79°22′–79°38′ E longitude). Each site was further divided into three sub sites i.e., Hill base, Hill slope and Hill top. At each site permanent plots were established.

2.2. Geology

Geologically the study sites were located in the Lesser Himalayan zone. The rocks of this zone are complex mixture of sedimentary, low grade metamorphosed and igneous rocks and belong to Krol series (Valdiya, 1980). The rocks in Banj-oak forest are infrakrol. These are black carbonaceous and pyritous, locally oxidized to ash-grey colour with characteristic oxidization rings on parting planes. The rocks in Chir-pine forest are formed of chlorite, sericite, schists, graniteferous micaschists and micaceous quartzites. While the rocks in Mixed oak-pine forest are complex mixture of mainly sedimentary low-grade

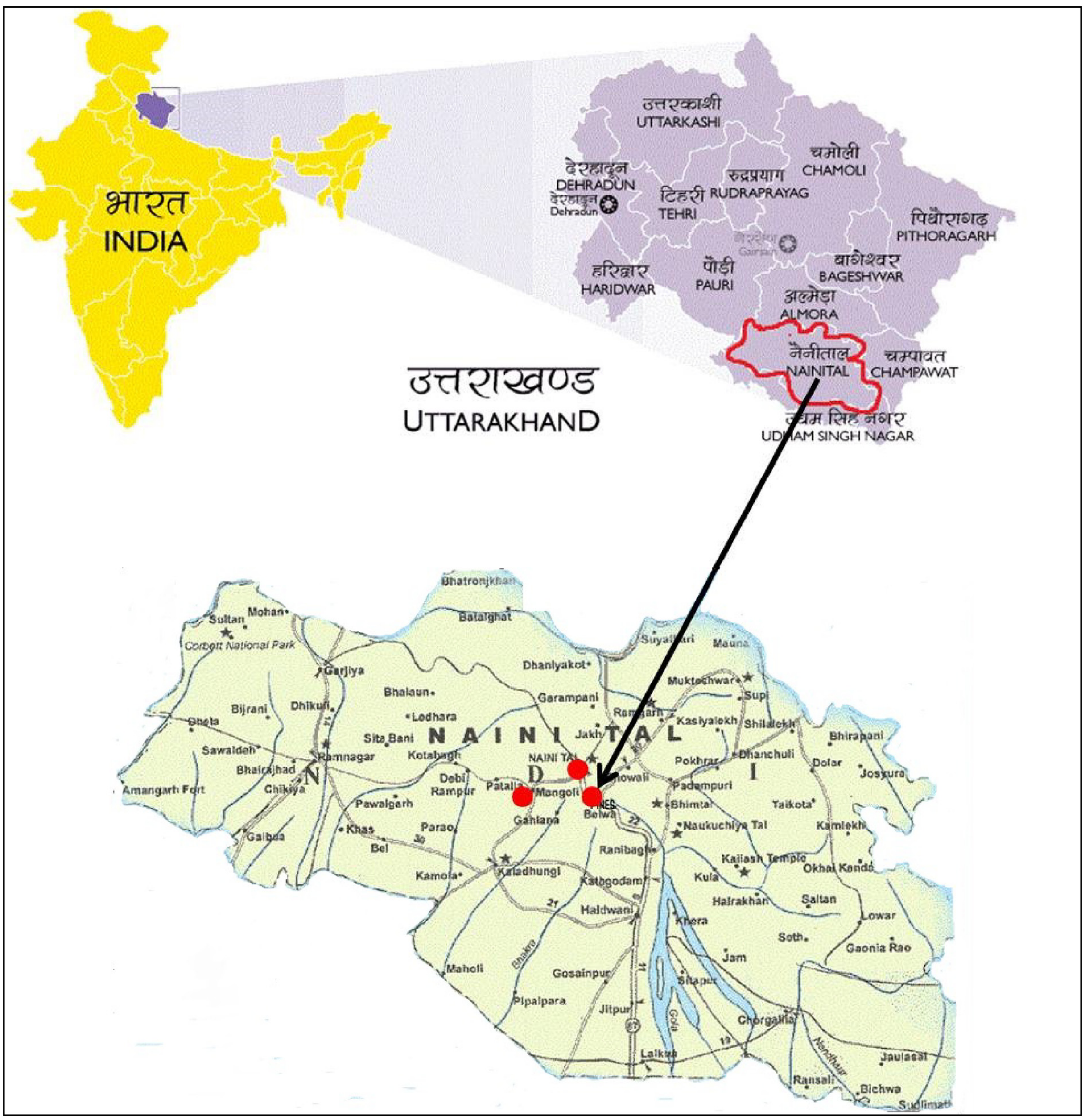

Fig. 1. Location map showing study sites.

Download English Version:

https://daneshyari.com/en/article/8893340

Download Persian Version:

https://daneshyari.com/article/8893340

Daneshyari.com