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The 21st International Grassland Congress / 8th International Rangeland Congress took place in Hohhot, China from June 29 through July 5, 2008.

Proceedings edited by Organizing Committee of 2008 IGC/IRC Conference

Published by Guangdong People's Publishing House

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Plant species composition and soil microbial community structure in a semi-natural grassland in Japan

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Key words : DGGE, plant functional types, soil chemical properties, soil microbial community

Introduction Plants and soil biota have a strong functional linkage as producers and decomposers of terrestrial ecosystems. However, structural associations between aboveground and belowground communities have not been well clarified. We examined plant species composition, soil properties (N availability, P₂O₅, pH, water content, total C and N%) and soil bacterial and fungal community composition in a semi-natural grassland in northern part of Japan. The objective of this study is to clarify how microbial community structure is associated with aboveground vegetation structure and local soil environments in semi-natural grassland.

Materials and methods The study was conducted in semi-natural grassland in Shiriyazaki (41°25'N and 141°26'E) located on northern Honshu, Japan (Hossain et al 2007). Thirty sites were selected at 50m interval along a 1.5km-long transect line and vegetation height and relative coverage of component species were examined in a 1×1 m plot at each site. Plant species were classified into four functional types: C₄ grasses, C₃ grasses, legumes, and forbs. Soil samples (40×40×60 mm deep) were then collected from the center of each plot, and soil pH, water content, N mineralization rate, soluble P₂O₅ content and total C and N % were measured. Soil bacterial and fungal community compositions were evaluated by denaturing gradient gel electrophoresis (DGGE) of 16S and 18S rDNA fragments and band pattern was analyzed by principal coordinate analysis (PCO) based on Jaccard similarity indices generated from binary data.

Result and discussion Soil pH ranged from 5.87 to 7.52, and soil C/N ratio ranged from 10.6 to 15.2. Plant species richness (m⁻²) ranged from 6 to 24 and was negatively correlated with soil phosphorus (P) content (r=-0.409*), which was negatively correlated with the proportion of forb species and positively correlated with the proportion of C₄ species. These results show that low soil P content leads to the dominance of forb species and resulting high species richness. Bacterial PCO1 scores, which represents community composition, showed significant correlations with soil pH (r=0.714**) and soil C/N ratio (r=0.606**). On the other hand, fungal PCO1 scores showed significant correlations with the proportion of C₃ species (r=-0.503*) and with soil C/N ratio; fungal PCO2 scores showed significant correlations with soil total C% (r=0.515*) and N% (r=0.476*). These results suggest that bacterial community structure is largely influenced by soil pH, while fungal community structure is influenced by plant species composition and soil organic matter content.

Reference

Hossain, M. Z., Okubo, A., Sugiyama, S. (2007). Local variation in soil microbial community structure in artificial and semi-natural grasslands, *Grassland Science* 53, 165-171.