Application of stable isotopes for estimating vertical distribution of fungal hyphae in soil

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1. INTRODUCTION

After the nuclear power plant accident at Fukushima prefecture in 2011, many researchers reported the ability of fungi to accumulate ^{137}Cs in fruit bodies as an important role of ^{137}Cs dynamics in forest ecosystem. In the previous study (Hayashi 2016), vertical hyphal distribution in soil was estimated based on C, N and S stable isotope ratios in fruit bodies and soil because it has been assumed that vertical hyphal distribution in soil was an important factor to determine ^{137}Cs concentration in fruit bodies since the report by Yoshida & Muramatsu (1994). In this study, the purpose is to evaluate the applicability of stable isotope data (^{13}C, ^{15}N and ^{34}S extracted by two different methods) to estimation of vertical hyphal distribution in soil, and to examine differences of isotope ratios between the two sites, and generality of vertical hyphal distribution in soil by comparing the results.

2. MATERIALS AND METHODS

(1) Study site

Two sites were selected for this research. One is Ashiu Forest Research Forest. This research forest belongs to the transitional area between the climate on the Japan Sea side and on the Pacific coast side. Thus, the flora of this forest belongs to the transitional area between the warm-temperature forest and the cool-temperature forest. The other study site is Kii-Oshima research forest. Ashiu research forest obtains sulfur mainly from rain fall and Kii-Oshima obtains isotopically heavy sulfur from sea spray.

(2) Sample and sulfur extraction

45 fruit body samples were collected in Ashiu and 25 fruit body samples were collected in Kii-Oshima. Soil samples also collected to 30cm depth including organic layers at three points in both sites.

$BaSO_4$ precipitates were extracted from fruit bodies and soil by Parr bomb and only from soil by shaking soil with deionized water.

3. RESULTS AND DISCUSSION

δ^{13}C, δ^{15}N and δ^{34}S values showed similar vertical profiles, becoming more positive with depth except δ^{34}S of bulk and soluble sulfur in Kii-Oshima research forest. δ^{34}S values of soluble sulfur of Kii-Oshima research forest showed small fluctuation in mineral soil layers compared to those of bulk sulfur and those of soluble sulfur of Ashiu research forest contained undetected values at some depth because of a shortage of $BaSO_4$ precipitation extracted from soil. By comparing isotope data at these two sites and Fukushima, some differences of estimated distribution of hyphae in soil were found. These differences may indicate that even same genera of fungi distribute their hyphae in different soil depth at different places.

CITATION

Hayashi T. 2016. Application of stable isotopes for estimating vertical hyphal distribution of fungal hyphae in soil. Graduation thesis, Faculty of Agriculture, Kyoto University

Yoshida S, Muramatsu Y. 1994. Accumulation of radiocesium in basidiomycetes collected from Japanese forests. Sci Total Environ. 157: 197-205.