学位論文内容の要旨

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学位論文題名

Characterization of arbuscular mycorrhizal fungal communities with respect to soil disturbance in a volcanic ecosystem

（土壌撹乱に着目した火山生態系におけるアーバスキュラー菌根菌群集の特徴付け）

Slopes of active volcanoes are a harsh habitat for plants; soil disturbance due to ash falling and erosion occurs frequently, and thus vegetation is generally poor, particularly near the crater (i.e. at higher elevations). Arbuscular mycorrhizal (AM) fungi play a significant role in the establishment and resilience of pioneer vegetation in harsh environments such as volcanic slopes. In this study, AM fungal community associated with *Miscanthus sinensis,* a pioneer grass species, in a volcanic slope of Mt. Tarumae was characterized with respect to soil disturbance.

1. Distribution of disturbance-tolerant AM fungi along a volcanic slope

In this chapter, I addressed the hypothesis that soil disturbance is a major ecological filter for AM fungi in volcanic ecosystems and thus the fungi that are more tolerant to soil disturbance are selected at higher elevations (i.e., nearer to the crater). Paired-soil-core samples were collected from 30 rhizospheres of *M. sinensis* between the vegetation limit and forest limit on a volcanic slope and used for trap culture with *M. sinensis* seedlings, in which one of the paired samples was sieved to destruct hyphal networks (disturbance treatment) while the other was not (intact treatment). After two months, DNA was extracted from the roots, and fungal rDNA was amplified and sequenced to determine community compositions. AM fungal diversity was decreased with increasing elevation, where nested structure was observed. Compositional

dissimilarity between the disturbed and intact communities was decreased with increasing elevation, suggesting that communities at higher elevations were more robust against soil disturbance. These observations suggest that AM fungi that are more tolerant to soil disturbance are more widely distributed across the ecosystem, that is, they are generalists. The wide distribution of disturbance-tolerant fungi may have significant implications for rapid resilience of vegetation after disturbance in the ecosystem.

2. Periodic disturbance as selection pressure for AM fungi

In this chapter, the impact of periodic soil disturbance on the fungal community was evaluated in a pot experiment. Three soil-core samples containing rhizosphere soil and roots were collected from each of four *M. sinensis* plants grown in a grassland above the boarder of forest limit in Mt. Tarumae. DNA was extracted from the roots in one of the three samples. The second sample was sieved with a 2-mm mesh to destruct hyphal networks of the fungi (disturbance), while the third one was not (intact). *M. sinensis* was grown in these soils in a greenhouse for 12 months, during which the soils in the disturbance treatment were sieved once a month. A small part of roots were collected every two months for DNA extraction. Using these DNA samples, Fungal rDNA was amplified and sequenced. Community compositions were differentiated by disturbance and over time, in which different taxa responded differently. For example, one of *Rhizophagus* spp. disappeared after several months in both communities, but reappeared only in the intact treatment. Whereas a dominant *Acaulospora* sp. were unresponsive to disturbance. Compositional dissimilarity between the disturbed and intact communities oscillated, indicating that succession occurred over time in both communities. These observations suggest that not only difference in disturbance tolerance but also that in life-history strategy of the community members shape the community structure under the selection pressure.